ENVIROHEALTH TECHNOLOGIES, INC.

QUALITY ASSURANCE DATA REVIEW

AS SPECIFIED BY EPA REGION 7

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**ENVIROHEALTH TECHNOLOGIES, INC.
QUALITY ASSURANCE MANUAL**

November 18, 1999
Revision 02, July 31, 2001

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Laboratory Director
Quality Assurance Coordinator

02/07/02

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QUALITY STATEMENT AND POLICIES

The purpose of this manual is twofold. Primarily, it is intended for use by the personnel of EnviroHealth Technologies (EHT) as a guide for established Laboratory Methods Protocol and Quality Control (QC) Program. Secondly, it is for reference by clients of the company as an assurance that the data reported by the Laboratory are obtained using approved analytical procedures and practices.

The commitment of EnviroHealth Technologies is to assure the highest degree of accuracy and precision in the analytical results obtained by methods performed at the Laboratory

The Laboratory's objective is to assure scientific reliability of laboratory data. Specific objectives are:

- To develop methods capable of meeting the needs for precision, accuracy, sensitivity, and specificity
- To establish the level of quality of routine performance
- To participate in quality evaluation programs with peer laboratories to achieve and maintain consistent levels of quality
- To improve and validate laboratory methodologies

The Laboratory shall ensure that its personnel are free from any commercial, financial and other pressures that might adversely affect the quality of their work, and clients are served with impartiality and integrity.

All employees shall conduct themselves and the business of the Laboratory in an honest and ethical manner.

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ETHICS POLICY

EnviroHealth Technologies, Inc. is committed to moral principles of right and wrong that conforms to accepted professional standards of conduct in the scientific community. All employees are expected to conduct themselves and the business of the Laboratory in an honest and ethical manner. Commitment to this ethics policy is demonstrated by compliance with the following principles.

- **Confidentiality** – Reports, data and other information pertaining to client analyses shall not be distributed or communicated to any person other than the person, or their representative, submitting the samples. Distribution of test results or other project information to a third party must be authorized by the client prior to release.

- **Conflicts of Interest** – Specific project information and sample identifications that result in analyst bias or conflicts shall be avoided. Employees of EnviroHealth Technologies, Inc. are required to report to the Laboratory Director any client relationship that may result in a conflict of interest between the client and the Laboratory, or Laboratory employee.

- **Undue Pressure** – The Laboratory shall ensure that its' personnel are free from any commercial, financial and other pressures that might adversely affect the quality of their work, and clients are served with impartiality and integrity.

- **Impartiality** – Employees shall treat all clients equally and remain free from all prejudice and favoritism that may affect the reliability of laboratory data.

POLICY OF UNETHICAL LABORATORY PRACTICES

EnviroHealth Technologies, Inc. supports a policy of zero tolerance for unethical activities in the Laboratory. Activities specifically prohibited are as follows:

- Making up data or other sampling and analysis information
- Misrepresentation of QC samples
- Improper clock setting or improper date/time recording
- Improper calibration/QC analysis
- File substitution
- Improper alteration of analytical conditions
- Unwarranted manipulation of computer software
- Intentionally over or under dilution of samples
- Lack of notification to management on identified

1.0   Introduction

EnviroHealth Technologies is dedicated to providing our clients with reliable laboratory analyses to assess the risk of personal exposure from adverse environmental conditions. In order to assure reliable data, this Quality Assurance Plan describes the policies, mechanisms, and procedures utilized within the Laboratory to achieve the accuracy, precision, reproducibility, legibility, defensibility, traceability, and completeness of documentation. In order for the plan to work effectively, it is recognized that all personnel have read and are familiar with its contents, and that they are committed to achieving the highest standards of both professional and personal integrity. Likewise, it is also recognized that management is fully committed to its implementation and that this commitment is clear to all personnel.

The ultimate responsibility for the performance of all Laboratory operation resides with the Laboratory Director. The Quality Assurance Coordinator is responsible for administration and maintenance of this Plan. This responsibility explicitly requires that the Quality Assurance function remains independent of the technical operation to the extent that no conflict of interest exists with the Laboratory. However, the Plan recognizes that the fulfillment of quality requirements is the responsibility of the entire organization.

The organizational chart presented in Figure 1 illustrates the relationship of personnel with respect to various functions of the Laboratory. Current operations require that some staff members be assigned multiple responsibilities until additional personnel are employed and qualified to assume specific duties.

2.0 Responsibilities, Qualifications and Training

2.1 Laboratory Director

The Laboratory Director shall have a bachelor's degree in an applicable physical or biological science, and either a minimum of five- (5) years industrial hygiene experience after the bachelor's degree or certification by the American Board of Industrial Hygiene (ABIH). Relevant academic experience may be substituted for work experience.

The Laboratory Director is designated as QA Coordinator for the Laboratory. The Supervisor for the Laboratory has been designated as Secondary QA Coordinator so that the implementation of the QA program remains steady and reliable for larger volumes of samples or personnel absences.

The Laboratory Director shall oversee all technical and administrative operations, analysis, and all reports generated in the Laboratory. The following are included in the Laboratory Director's responsibilities:

- Maintain expertise in all methodologies used in the analyses performed by the Laboratory
- Supervise the training of new Analysts
- Ensure expedient completion of all samples submitted for analysis
- Review and sign all reports released to the clients to ensure quality reporting and accuracy of results
- Ensure that current and updated procedures and methodologies are available for review by the Analysts
- Be available for any consultation requested by the Analysts
- Ensure regular maintenance and calibration of equipment
- Oversee all purchases in the Laboratory
- Coordinate with the Supervisor of the Laboratory and the Office Manager on Laboratory operations
- Be available for client contact and inquiries

2.2 Quality Assurance Coordinator

The Quality Assurance (QA) Coordinator shall possess a BS degree in a basic or applied science and have at least one year of non-academic analytical chemistry experience, or four years of non-academic analytical chemistry experience. In addition, documented training in statistics and quality control procedures is required.

It shall be the duty of the QA Coordinator to ensure compliance with the QA Program. The QA Coordinator shall monitor the quality control activities, and carry out the following:

- Develop and implement QA practices and take any measures necessary to maintain and assure conformance to the authorized QA standards in order to achieve accuracy and precision of data produced
- Follow and evaluate current developments and practices in the field of analytical techniques and advise the staff of possible applications
- Assign Quality Control (QC) samples and evaluate the results
- Monitor Laboratory QA Program operations in order to fulfill all of the validated requirements outlined in the program

- Periodically prepare a summary of QC performance per Analyst and form an evaluation of the Analyst which shall include any suggestions that may improve the Analyst's technical performance
- Maintain and update the personnel folder for each staff member which shall include:
  - Resume of qualifications
  - Assigned laboratory procedures
  - Monthly summaries of QC performance
  - Training documents
  - Job responsibilities
- Ensure regular maintenance and calibration of all equipment and analytical materials
- Document and date as revised any revisions in the quality assurance program
- Assimilate any changes in methodology, personnel, or any other aspect addressed in the QA manual in a timely manner

The QA Coordinator shall periodically review the Laboratory QA Program to determine if any testing deficiencies exist. This check shall be recorded in a permanent record along with any corrective actions taken to improve accuracy and precision of analytical performance.

2.3   Laboratory Supervisor

The Supervisor of the Laboratory shall possess a bachelor's degree in an applicable physical or biological science, and either a minimum of five- (5) years relevant experience or current certification in chemical practice by the ABIH. A minimum of two and one-half (2 ½) years experience must be in industrial hygiene analyses.

The Supervisor of the Laboratory shall oversee all operations and analysis in the Laboratory. The following are included in the responsibilities:

- Maintain expertise in all methodologies used in analyses performed at the Laboratory
- Supervise the training of new Analysts for the determination of fiber content in air samples
- Ensure expedient completion of all samples submitted for analysis
- Ensure that current and updated procedures and methodologies are available for review by the Analysts
- Be available for any consultation requested by the Analysts
- Ensure regular maintenance and calibration of equipment
- Coordinate with the Laboratory Director and the Laboratory Office Manager on Laboratory operations
- Make necessary purchases for the Laboratory upon approval by the Laboratory Director
- Be available for client contact and inquiries

2.4   Analyst/Chemist

Analysts must have a Bachelor of Science degree or equivalent in chemistry or a related field. Successful training (an in-house course is acceptable) in specific methodologies used in the laboratory shall be documented. The Analyst shall have demonstrated ability to produce reliable results through accurate analyses of standard reference materials, proficiency testing samples, or in-house quality control samples at a minimum of every six (6) months. All analysts must have a

minimum of thirty (30) calendar days of hands-on experience conducting analyses in an inorganic/metals laboratory before initiation of work in samples. All of the performance criteria must be documented in the analysts personnel file.

Analysts performing fiber counting must have completed a NIOSH 582 or equivalent course.

Analysts performing bulk asbestos analysis must complete a course on polarized light microscopy or equivalent.

The following responsibilities are designated to the Analyst:

- Accurately and conscientiously perform assigned analyses
- Conscientiously correct or adjust for any errors revealed in the monthly summary of QC performance checks
- Maintain and record instrument calibration as needed to assure accurate and precise data production
- Complete assigned QC samples in a timely manner

The Analyst shall be responsible for the understanding of assigned methodologies and techniques available for review in the Standard Operating Procedures Manual. At a minimum, the Analyst shall successfully complete the training requirements as outlined in this manual.

2.5   Analyst-in-Training

The primary responsibility of the Analyst-in-Training shall be to consistently and conscientiously strive to achieve experience, expertise, and a clear understanding of the techniques involved in the assigned analytical methodologies.

The Analyst-in-training shall be responsible for the conscientious pursuit of the understanding of assigned methodologies and techniques available for review in the Laboratory Methods Manual.

All Analyst-in-Training must be trained with the SOPs in use in the laboratory and with the instrument and equipment operation manuals. A minimum of four (4) independent test runs of sample preparation and/or instrumental analysis for each matrix. For sample preparation training, the recoveries of the associated reference materials or proficiency training samples for each run must be within +/_ 20 percent of the certified value, 75 percent of the time. For instrumental analysis training, the recoveries of the associated reference materials or proficiency training samples for each run must be within +/- 10 percent of the certified value, 75 percent of the time.

2.6   Laboratory Office Manager

The Laboratory Office Manager shall oversee all administrative operations. The following are included in the Office Manager's responsibilities:

- Supervise Laboratory Office personnel
- Review all final reports and invoices before submittal to the Laboratory Director for review and release
- Maintain office inventory to include computers, typewriters, photocopier, facsimile machine, and all miscellaneous materials

- Maintain and update office files for easy reference when needed
- Log sample submittals into the Sample Log System
- Train new Laboratory Office Personnel in standard office operational practices
- Address client inquiries concerning reports or billing
- Coordinate with the Laboratory Director and the Supervisor on Laboratory administrative operations

2.7 Laboratory Office Personnel

The following responsibilities shall apply:

- Perform duties assigned, with supervision as needed
- Type reports, invoices, and correspondence
- File all completed paperwork in the appropriate locations
- Coordinate with the Laboratory Office Manager on all clerical operations

2.8 Training and Proficiency

All personnel must receive the necessary technical training to assure that Laboratory procedures are understood and followed so that data of known and expected quality is demonstrated during routine performance of the methods assigned. Training shall include the proper operation of equipment and instrumentation, as well as the Laboratory procedures that detail the method of analysis. Only after demonstration of proficiency may laboratory personnel be authorized to perform the assign method and operate equipment designated in the procedure.

Employee training is the responsibility of the Laboratory Supervisor for that group, the Laboratory Quality Assurance Coordinator and Laboratory Director. The training must be documented in Laboratory records and include a description of the content and duration of the program.

With the approval of the Laboratory Director and Quality Assurance Coordinator, analysts with prior analytical and technical experience may demonstrate proficiency to perform Laboratory procedures by satisfactorily completion of evaluation samples.

Technical training for analytical procedures may include the use of reading materials or study guides, side-by-side analysis with an experienced analyst, and extensive hands-on duplicate and replicate analyses utilizing known samples including American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing samples.

The duration of the training period is dependent on the analysts' prior analytical and technical experience. The judgment to allow an Analyst-in-Training to perform analyses of unknown samples submitted to the Laboratory relies solely upon the approval of the Quality Assurance Coordinator and Laboratory Director. The decision shall be based on review of all practice duplicates, replicates, and side-by-side analyses performed during training.

The Analyst-in-Training that demonstrates competence in the methodology and acceptable results in the course of the training program, shall be judged proficient in the analysis of unknown

samples. Initially, the results from each new Analyst shall be reviewed on a more frequent basis and supervised to ensure only quality data is submitted to the client.

Analysts involved in the evaluation of samples submitted to the Laboratory must participate in the proficiency-testing program by individually analyzing, recording, and reporting test results in-house for each of the round robin samples. Analyst's proficiency testing results are to be incorporated into the respective QA performance records and be evaluated along with the regular QC sample results.

EnviroHealth Technologies, Inc. actively supports employees' continuing education efforts, to include:

- Individual study related to method technology
- Active participation in Laboratory meetings in which analytical techniques, unique samples, general operational procedures of the Laboratory, and QC performance checks are discussed
- Attendance of conferences, technical seminars, educational courses, etc.

ENVIROHEALTH TECHNOLOGIES, INC.

Organizational Chart

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┌─────────────────────────────┐
│   William J. Lowry, CIH      │
│   President/Director         │
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┌─────────────────────────────┐
│   William J. Lowry, CIH      │
│   Quality Control Coordinator│
└─────────────────────────────┘
              │
┌──────────────────┐   ┌─────────────────────────────┐
│  Peggy D. Rogers │───│   William J. Lowry          │
│  Administration  │   │   Technical Manager         │
└──────────────────┘   └─────────────────────────────┘
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MICROSCOPY	CHEMISTRY	FIELD OPERATIONS
Stuart Kinquist PCM/PLM/TEM Analyst Secondary QA Coordinator (PCM) Jerry Dissault Analyst (PCM) Matthew Temper Analyst (PCM) Darren Doderer Analyst (PCM)	William Lowry, Analyst Edward Scalf Analyst Stuart Kinquist, Analyst-in-Training	William J. Lowry Field Operations Supervisor Jerry Dissault Air Sampling Professional Stuart Kinquist Air Sampling Professional Matthew Temper Site Supervisor

3.0 QA Manuals and Procedures Adoption/Review

EHT Policy and Analytical Standard Operating Procedure's (SOP's) are reviewed on an annual basis to assess current applicability. New analytical procedures, as well as other policy procedures, must be prepared, reviewed, and approved prior to implementation at EHT. Training in accordance with the EHT Chemical Hygiene Plan must be conducted for company personnel prior to conducting an assigned test method.

The QA Coordinator shall routinely maintain and update the QA procedures as needed to improve the QA Program. Changes to the Program shall be documented in the Manual when implemented at the Laboratory. The QA Manual and procedures shall be reviewed annually to audit and update the QA procedures performed at EnviroHealth Technologies, Inc.

Any changes in analytical procedures must receive prior approval by the Laboratory Director or Supervisor, and be documented in the SOP.

EHT shall use test methods that are appropriate and that meet the needs of the client. The Laboratory shall inform the client of the selected method whenever the client does not specify their preferred method, or if the client proposed a method that is not appropriate.

Non-standard methods must be clearly written, validated and accepted by the client. New test methods must contain the following information.

a) Name of Method
b) Scope
c) Sample description being tested
d) Analytical parameters to be quantitatively or qualitatively determined
e) Apparatus and equipment, including performance requirements
f) Required reference standards and materials
g) Method-defined environmental conditions
h) Description of the procedure
i) Safety considerations
j) Criteria for acceptance and rejection of results
k) Data to be recorded
l) QA acceptance requirements or criteria
m) Estimates of bias and precision

All test methods shall be validated to ensure the appropriateness of the method for its use and shall be relevant to the client's need. Validations shall be recorded and retained. Validation techniques may include the use of reference materials, comparison of results achieved with other methods and inter-laboratory comparisons. Method performance criteria and acceptance limits shall be stated.

4.0   Sampling Materials and Procedures

Information regarding sampling materials, sampling containers, preservatives, and shipping instructions shall be available to clients through the Laboratory.

EnviroHealth Technologies will inform clients what method to reference so they can take an acceptable sample. EHT will also make available, when requested, containers, preservatives and shipping instructions. Where appropriate, EHT will request that the client submits field blanks with their samples. Any deviations from the method EHT references will be recorded in the analyst lab book and communicated to the client.

All sampling materials provide by EnviroHealth Technologies will meet, or exceed, the method referenced to the client. Specifically, wipe sample material submitted to EnviroHealth Technologies must meet ASTM E 1972, Standard Specification for Wipe Sampling Materials for Lead in Surface Dust. Results for wipes submitted to the Laboratory for lead analysis must indicate that they are not recognized within the accreditation program.

5.0   Reagents and Standards

Reagents and standards shall be consistent with the requirements of the method performed. The reagents and standards shall be inspected, dated, and initialed upon receipt. Primary standards and analytical reagents shall have an expiration or re-evaluation date assigned on the container. Reagents and standards shall not be used beyond the assigned expiration date. Materials designated for re-evaluation shall be assigned a new expiration date if found to have an adequate purity. Expiration dates of reagents and standards must be maintained in the Reagent/Standard Log. Calibration standards shall be traceable to National Institute of Standards and Technology (NIST) or an equivalent national or international standard where possible. All standard and solution preparations shall include the date of preparation, concentration and/or purity of the parent material, assigned expiration date, and the preparer's initials.

6.0　Procurement

Procurement, receipt, and storage of items required for use at EnviroHealth Technologies shall follow the procedures as specified in the Chemical Hygiene Plan.

Suppliers of critical consumables, supplies, and services that may affect the quality of testing must be evaluated to determine compliance with the methods for the tests and/or calibrations concerned. The services or supplies used must comply with the specified requirements of the method. Suppliers may be approved by such criteria as a vendor of record, by reputation, through a trial period, qualification, or other means as long as the material or service demonstrates adequate performance to maintain the quality of testing.

Records of the evaluations and listing of approved vendors must be maintained by the laboratory as a reference prior to procurement.

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7.0 Analytical Methods

Airborne asbestos analyses must comply with the quality assurance requirements of the Asbestos Standard Appendix A, CFR1910.1001, most current revision of the NIOSH 7400 analytical method and elements of the accreditation policies for the AIHA. The test method and quality procedures are documented in applicable EHT Standard Operating Procedures and "Airborne Fiber Concentrations Quality Assurance Manual".

Bulk asbestos analyses must comply with the quality assurance requirements of the U.S. Environmental Protection Agency Test Method EPA/600/R-93/116 and elements of the accreditation policies for the National Institute of Standards and Technology National Voluntary Laboratory Accreditation Program. The test method and quality procedures are documented in applicable EHT Standard Operating Procedures and "Asbestos Bulk Laboratory Methods Protocol and Quality Assurance Manual".

Industrial hygiene analytical method procedures are documented in EHT's reference method Standard Operating Procedures. These are procedures specifically based upon documented methodologies prepared by regulatory agencies or recognized organizations such as NIOSH, OSHA, USEPA and ASTM.

EnviroHealth Technologies SOP's remain in a draft form until linear calibration ranges and method detection limits are established and statistically verified. Approval by the Laboratory Director and Quality Assurance Coordinator must be obtained prior to incorporation into Laboratory operations. The Laboratory Director and Quality Assurance Coordinator must approve all revisions and annual review of SOPs.

Annual review of analytical SOP's must also include statistical verification of the method working calibration range and detection limits.

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8.0   Chain of Custody Policies

EHT personnel receiving samples for analysis shall complete the internal Chain-of Custody (COC) form. Minimum information to be documented shall include the acceptability of the sample, to the best of their ability, at the time of receipt, client information sufficient for log-in procedures, client instructions pertaining to the sample set, and name of the staff member receiving the sample.

The Laboratory adheres to the following Chain-Of-Custody policies:

- Should the client submit or request a chain-of-custody form for the sample(s), the chain-of-custody form shall remain with the work order form
- Should the samples be returned to the client, the original, completed chain-of-custody shall accompany the samples; a copy shall also be attached to the work order and filed in the Laboratory Office
- Should the samples need to be retained by the Laboratory, the completed COC form will be retained with the work order in the Laboratory Office files
- Where no chain-of-custody is required or requested by the client, the EHT work order shall serve as the chain-of-custody

The Laboratory "Work Order" request form shall act as an internal chain-of-custody and accompany the sample or samples throughout the Laboratory. A duplicate copy of the "Work Order" request must be filed in the sample location binder while in process of analysis. Each analyst or other staff member in possession of the sample must initial this copy so that the owner may be identified at any time. Disposition of the sample upon completion of analysis must be documented on the Work Order form which is to be bound with all applicable documentation and filed with the other completed projects.

9.0   Sample Receiving

Pertinent information on all samples submitted to EHT is entered into the computer login system in the central office immediately upon receipt. Each sample is assigned a unique EHT Laboratory number (in strict numerical sequence) that is attached to the sample. Log-in data shall include the date received at the laboratory, EHT Report Number, client information, Laboratory assignment, description of sample and analysis required, assigned EHT Laboratory Number(s), due date (if applicable), acceptability of the sample upon receipt, and individual receiving the sample for EHT. Date reported, date invoiced, and invoice number shall be entered upon release of final report to the client.

10.0   Equipment

10.1   Instrument Maintenance and Calibration

Calibration and maintenance of instruments and other items used for analysis are integral parts of EHT daily operations. Analytical SOP's and manufacturer guidelines detail method specific procedures used by laboratory personnel authorized to operate the equipment. Refer to Section 2.8 Training and Proficiency.

Routine operation requires instrument performance checks prior to analysis. Each instrument must be appropriate for the analysis being performed. Instrument sensitivity, linearity, noise level, and response levels versus historical values are validated when required by the method. A minimum of three calibration standards that bracket the sample concentrations and a blank are analyzed each day of use to construct calibration curves for applicable procedures. Acceptable criteria shall be documented as the relative percent difference of response factors or correlation coefficient. Calibration standards and blanks shall be continuously analyzed in accordance with the specified test method to verify the stated acceptance criteria.

Initial calibration verification (ICV) is a term applied to the use of standards prepared independently from a source other than that of the calibration standards, or at least from the Neat standard used to prepare the stock standard. ICV standards shall be used during each batch of analyses to verify that the instrument calibration or standardization is within the acceptance criteria stated for each method of analysis.

Calibration and maintenance of support equipment shall be performed in accordance with required procedures and documented in the equipment log. Equipment that goes outside the direct control of the laboratory shall be checked for function and calibration prior to being returned to service.

Preventative maintenance and instrument repairs shall be documented in the appropriate instrument log. In each case, all service and calibration actions shall be recorded on the Equipment Maintenance/Calibration Log, and all other appropriate locations, for that particular unit of equipment. Maintenance and repair information to be recorded shall include the problem or service description, dates and types of repair, and person performing the repair. Manufacturer operating manuals or equivalent shall be available for reference by analysts.

If a unit of equipment is in disrepair and not adequate for the required function, it shall be removed from active use until the repair and calibration have been satisfactorily completed. Out of service equipment shall be isolated, or clearly marked as non-operational, until it has been repaired. The Laboratory shall investigate whether the equipment place out-of-service has affected any past reported results

10.2   Computers

The Laboratory uses computers for the capture, processing, manipulation, recording, reporting, storage and retrieval of test data. To ensure the continued integrity of captured data the following procedures must be supported by all Laboratory personnel.

A. Computer hardware and software shall be applicable for the intended use. Hardware shall be selected in accordance with specifications designated by a contracted computer consultant

qualified by certification and experience. Name brand software shall be utilized when applicable. Computer programming for critical usage at the Laboratory is currently developed, documented and maintained by contracted qualified computer consultants licensed by the appropriate manufacturer or agency. The contracted computer consultant shall act as system administrator until such time as qualified Laboratory personnel are available.

B. Various levels of access to computer software and data are controlled by the system administrator and password protection. Data entry and modification shall be restricted to authorized Laboratory personnel. The program administrator shall provide access to sensitive computer data by authorized personnel as designated by the Laboratory Director.

C. Every measure will be taken to protect the integrity and security of computer programming and test data. Backup tapes and disks shall be in duplicate with one copy available at the Laboratory and the second to be archived at a designated area other than the Laboratory. The Office Manager is responsible for weekly backup using alternating compact disks, or floppy disks when appropriate, so that the loss of any one set will result in updating one week's data.

D. Contracted computer consultants qualified and accredited as experts currently maintain all computer equipment to ensure proper performance of the system hardware and software.

E. Computer operations that affect data and test results must be verified to demonstrate the data's integrity and accuracy by an alternate technique such as manual calculation.

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11.0   Data Reduction, Evaluation, and Reporting

One on the most important aspects of quality control is that of data review and documentation. It is the responsibility of the Analyst to review their work to confirm that all necessary raw data, calculations, and information pertaining to the analysis are checked and properly copied or cross-referenced for subsequent review. Items to be included in a raw data package may include, but not necessarily be limited to, the following:

- Instrument output and sequence logs
- Standards log, including preparation and source
- Referenced methodology
- Raw data sheet/sample preparation log
- Analyst signatures/dates of analyses
- Signature/date of second party review
- Measurements below the method quantitation limit are reported as "<" (less than) or "ND" (none detected) and the quantitation limit is referenced for reporting to the client
- The number of significant figures reported reflects the precision of the analysis.

In general, the raw data package should be prepared by the Analyst in such a way that another analyst who is familiar with the analysis would be able to trace all steps taken during the course of the analysis, calculations, and reporting without requiring additional information.

When the Analyst who performed the analysis provides a review of the raw data package, this process is often referred to as "first party review". Review by a second Analyst, familiar with but not directly involved in the analysis, is often referred to as "second party review". Items that must be reviewed during "second party review" include, but are not necessarily limited to:

- Transcription errors
- Proper reporting of detection limits
- Appropriate method references
- Proper sample/laboratory identification
- Dilution factor calculation.

Any change or correction to the data sheet shall be made by a single strikeout line, initialed and dated, shall be used for changes or corrections. Indelible ink shall be use for all written data and no correction fluid may be used on original laboratory documentation. Other levels of QC review are encouraged if practical, however the next level of review usually takes place during the quality assurance process.

After evaluation of the QC results, the Laboratory Director, Supervisor of the Laboratory, or a designated person, shall audit the report. The audit is comprised of the following:

- Inspection to ensure that the EHT Laboratory Number, the client sample identification, and the final results correspond
- Completion of all accompanying paperwork such as chain-of-custody forms, sample transmittal forms, etc.
- Assignment of laboratory charges for analysis performed including a breakdown of pricing by Analyst
- Assignment of any special reporting, billing, or chain-of-custody instruction

- Provide verbal or fax results to client when requested
- Storage of samples for distribution to the proper location (see COC Policies)
- Submittal of all paperwork to the Laboratory Office for report generation

11.1 Data Reporting

Data must be reported in a format that is easily understood by the client and inhibits misuse or misrepresentation. The final report issued to the client must, at a minimum, include the following elements:

- Title (e.g., "Test Report").
- Name, address and telephone number of the laboratory.
- Page number and total page numbers on each page.
- Unique identification of the test report on each page and a clear identification of the end of the report.
- Name and address of the client.
- Description, condition and identification of the test sample and the date received by the laboratory.
- Reference to the sampling plan and procedures, if applicable.
- Identification of the test method, sample results, units of measurement and reporting limit.
- Modification to the test method, if applicable.
- The name, title and signature or equivalent identification (however produced) of the staff members(s) accepting technical responsibility for the content of the original or corrected test reports. The approved signatory shall be the laboratory manger or his/her designee.
- Date of issue and date analyzed.
- Where relevant, a statement to the effect that the results relate only to the items tested.
- Test results performed by a subcontractor shall be clearly identified.
- Test results not covered under the AIHA accreditation shall be clearly identified.

All corrections or additions to a test report shall be documented on the work order form and final report of results to the client. All test reports shall be labeled with the issue number to designate whether the copy is original, or amended. The original report number must remain constant on all corrections or additions to the test report.

The significant figures used to report data to the client must not exceed the precision of the analysis. Precision of each analysis may be determined by the reference method, statistical analysis of the data, or from past experiences.

12.0   Client Communication

12.1   Documentation of Communication

A record shall be maintained of all verbal communications with the client, including any complaints, and of the actions taken by the Laboratory. Client "Inquiry" forms shall be maintained as a reference to conversations and other communications with the Laboratory.

12.2   Requests for Data Validation

In that instance where the client requests a verification of data reported, the data sources and all data transfer steps (e.g. transposition of data onto computer system) are checked, as well as repeat analyses performed, when found necessary. Should an error occur, every attempt must be made to identify the source. Any corrections shall be documented and an amended report is released to the client.

In some instances, the sample(s) in question may be submitted to another reputable laboratory for confirmation of results.

12.3   Client Agreements (Contracts)

Client requests for analysis and agreements, or contracts, for services must be reviewed by the Laboratory Director or Laboratory Supervisor to assure that the requirements for testing are understood and appropriate for the Laboratory capabilities. The client must be notified of any deviation from the original agreement. Documentation of the amended agreement and requests must be distributed to all persons affected by the change.

12.4   Client Complaints

The Laboratory Director will address all client inquiries dealing with complaints or questions associated with the analysis. An audit must be conducted to determine the source of any discrepancy found in the analytical procedures or report generation. The results of the audit must be documented and attached to the analysis packet.

The Laboratory Director may discuss with the client the test methods and any limitations that may occur.

Data validation may be performed as stated above.

12.5   Confidentiality and Proprietary Rights

Results or client product information will not in any way be released by any employee of EnviroHealth Technologies to other parties without the expressed authorization of the client or their representative. In the event the Laboratory documents are subpoenaed, the client will be immediately notified.

All staff members are required to sign an agreement that acknowledges their responsibility to protect the confidentiality and proprietary rights of the client.

13.0 Internal Quality Control Procedures

EHT quality assurance program requires strict adherence to the QA/QC requirements in the test methods used. Any deviation from these procedures required in EHT SOP's or reference methods must be documented and reported to the client.

Quality control by analysts includes performing analysis of samples or prepared standards especially designated to demonstrate accuracy, precision, criteria for acceptance, and reproducibility of the analytical results. This is accomplished by performing the following analyses, where applicable, during the batch analyses:

- Reagent Blanks – Reagent blanks are aqueous solutions or solvent extracts representing the same matrix as standards but containing no analytes of interest. The reagent blank is analyzed to demonstrate that the reagent matrix is contributing no analyte response.
- Media Blanks – Media blanks are essentially reagent blanks that include the media used to collect the sample. Differences in responses for an analyte between the method blank and reagent blank often reflect contamination of the media material.
- Replicates - When samples, spiked samples, or standards are analyzed three or more times to determine reproducibility, they are described as being replicates. When they are analyzed twice, they are commonly describes as duplicates.
- Media Spikes – Media spikes, often referred to as laboratory fortified blanks, are media blanks to which have been added, or "spiked", analytes of interest at a known concentration. Analysis of a media spike is designed to demonstrate the ability of the Analyst to recover the analytes of interest, typically from reagent water, using a sample preparation technique where the sample matrix cannot be responsible for recovery variations.

Accuracy and Precision studies are performed to demonstrate, through multiple analytical determinations, how accurate and/or precise the value derived from the determination is with respect to its true value. Precision is generally defined as a measure of the degree of agreement among replicate analyses of a sample, usually expressed as the standard deviation whereas accuracy is generally defined as a combination of bias and precision of an analytical procedure which reflects the closeness of a measured value to a true value. The concentration used for determination of both precision and accuracy should be bracketed by and calculated from standards of lower and higher concentrations. Both precision and accuracy values should always be referenced to the concentration used for determination, as well as to the matrix used.

The acceptable limits are established for each method based on statistical evaluation of the data generated by the analysis of the quality control samples. Laboratory determined acceptable limits should be compared to stated method limits when available. Statistical evaluation of the QC data is performed in respect to the following considerations:

- Response factors (RF) – Response factors may be determined anytime an analog or digital signal from an instrument may be directly related to the concentration of the analyte responsible for the signal. Examples of these signals, or responses, may be an integrated peak area, light emission intensity, or light absorption intensity. The response factor is then a ratio of the response to the known value of the concentration, expressed as concentration/response. Multiplication of the response for an analyte of unknown concentration by the response factor provides a numerical value for the concentration as follows:

Response x (Concentration/Response) = Concentration

When the response factors from more than one determination are averaged, the average RF may then be used analogously. An average RF may be determined when multiple analyses are made of the same standard or single analyses are made of multiple analyte concentrations, and may be applied as a numerical value for single and multi-point calibrations.

The response factors discussed so far have been determined using the external standardization technique, where only the concentration and response of the analyte itself contributes to the response factor. Often this approach is inadequate for accurate measurements as the response, and response factor, for a given analyte concentration is not reproducible for a variety of reasons. When this is the case, the technique of internal standardization is often employed. An internal standard is an analyte that is added to known concentration to the sample (typically a sample extract) just prior to analysis. The internal standard analyte is selected to "mimic" the characteristics of the analytes of interest, to the extent that any irreproducibility of the response factors is observed analogously with the internal standard and corrected accordingly. The resultant response factor is described as a relative response factor (RRF) as may be calculated as shown below:

$$RRF = \frac{\text{Internal Standard RF}}{\text{Analyte RF}}$$

RRF values typically range from 0.2 to 5.0, with a value greater than 1.0 meaning that the analyte has a larger response than the internal standard for an equivalent concentration.

In addition to normalization of the response factor, a quantitative value, the internal standard technique may also be used for qualitative purposes. This technique is commonly used with chromatographic applications and is especially useful when manual injections are made or very accurate retention time data is critical to the identification of the analyte.

- Relative Standard Deviation (RSD) – Relative standard deviation is a value used to describe the reproducibility of analytical determinations and is most often applied to multi-points calibration curve response factors (RF or RRF) or multiple (three or more) determinations of a particular analyte concentration. When only two values are being compared to one another, the term Relative Percent Difference (RPD), below, is usually more applicable. Often this value is reported as percent relative standard deviation (%RSD), calculated as shown below:

$$\%RSD = (\text{relative standard deviation}) \times 100 = (SD/X) * 100$$

Where: X = Calculated mean of the multiple determinations, and
SD = Standard Deviation of the multiple determinations

- Relative Percent Difference (RPD) – Relative percent difference is the relative difference (RD) of two values expressed as a percentage and is essentially a %RSD calculated using only two data points. It is calculated as shown:

$$\% RPD = \text{Relative Difference} \times 100 = [(R1 - R2)/\{(R1 + R2)/2\}] \times 100$$

Where: R1 = first response (or RF, RRF, average, etc.)
R2 = second response (or RF, RRF, average, etc.)

It should be noted that the standard deviation, SD, is derived statistically from the summation of the individual RD's.

- Percent Difference – Percent difference is statistically equivalent to %RSD but is typically applied to calibration, e.g., response factor, verification where a current determination is compared to a calibration curve created earlier to verify that the average response factor has not changed significantly.

- Percent Recovery – Percent recovery is a value calculated as a percentage, describing the ration of analyte concentration found to analyte concentration spiked for any sample containing a spike compound.

- Blind Re-Counts (Asbestos Fibers) - In accordance with NIOSH Method 7400, and 29 CFR 1910, Appendix A, the following test is used to determine if duplicate counts of the same sample by the same Analyst should be rejected due to possible bias, or accepted as accurate. The sample results should be discarded if the difference between the square roots of the two fiber counts (in fibers/mm^2) exceeds the product:

$$(2.77)(X)(CV)$$

Where: (X) = average of the square roots of the two fiber counts (in fibers/mm^2)
(CV) = one-half inter-counter relative standard deviation derived from in-house historical data

This technique estimates the counting reproducibility at the 95% confidence level.

EHT uses control charts and quality control databases to record quality control data and compare quality control data with acceptance limits. Control charts are hardcopy representations of current quality control criteria generated from studies utilizing the quality control data. Control charts are commonly prepared from recovery and replicate data for samples, sample spikes, and surrogates. The purpose of the control chart is to provide, in graphic form, both a historical perspective of how the criteria were derived and a quick visual check of the values for the current criteria. Control charts should be clearly marked to describe the source of the data, e.g., spikes, replicates, and whether the data was derived from performance evaluation samples as opposed to "real" samples.

Uncertainty of Measurement

Reasonable estimation of Uncertainty of Measurement is based on knowledge of performance of the test method and uses previous experience and method validation data. Standard test methods published by agencies such as OSHA, NIOSH, ASTM and the EPA that includes this information will be used as long as all method steps are followed. The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as the requirements of the test method, governing regulations, and the requirements of the client. Uncertainty of measurement is not required for qualitative determinations.

Guidance documents used when the Estimate of Uncertainty must be determined msy included "Estimation of Laboratory Analytical Uncertainty", by Thomas Georgian, Ph.D. published in Environmental Testing & Analysis, Nov/Dec 2000 and the procedure "Analysis of Uncertainty" published by Steve Lerman of SIL Consulting.

Non-conformance or deviation of work

Samples received by EnviroHealth Technologies are reviewed by the Laboratory Director to determine applicable methodology. EHT requires that all policies, procedures, and standard specifications be adhered to on a regular day-to-day basis. However, it is recognized that, on occasion, minor deviations may be required on a temporary basis to facilitate laboratory operations.

These deviations, or variances, must be minor in nature and not adversely effect the overall operation of the laboratory or validity of analysis. The deviation must not be performed until after receipt of written approval by the Laboratory Director and Quality Assurance Coordinator. All aspects of the deviation must be recorded in the analyst workbook, instrument maintenance record, or other appropriate location of documentation.

"New Work", defined as unusual samples, or methods requested by the client, shall receive special attention as to the capabilities of analysts and the Laboratory. Deviation from documented Laboratory procedures must be verbally stated to the client and explained on the final report. "New Work" not applicable to the facilities, personnel and resources available in the at the Laboratory must be rejected.

14.0 Performance and System Audits

14.1 Performance Audits

Performance audits are conducted to examine the results of proficiency testing programs in the laboratory. These programs are comprised of evaluation samples on a periodic basis from the AIHA, the National Voluntary Laboratory Accreditation Program, independent supplier of quality control samples (such as NIST), and periodic in-house laboratory control samples.

An integral part of any quality control program is to routinely analyze samples of known concentration but which are unknown to the analyst. This is often described as "blind" QC and is the quality assurance equivalent of an audit. Many accreditation or certification programs require that analyses be performed routinely, and supply their own performance evaluation samples of proficiency "unknowns" for inter-laboratory analysis. These round robins are an integral part of EHT's quality assurance program. In addition to participating in the AIHA's PAT round robin and the National Voluntary Laboratory Accreditation Program, EHT participates in a minimum of three- (3) QA round robins per year with other qualified laboratories.

The participating laboratories are:

Metals, solvents, and bulk asbestos

McDonnell Douglas Corporation
P.O. Box 516
St. Louis, MO 63116
Dept. 257, Bldg. 102, M/C 1022152

St. Louis County Health Department
111 S. Meramec Avenue
Clayton, MO 63105

Asbestos (air)

Precision Analysis
1030 Acorn Trail Drive
St. Louis, MO 63031

McDonnell Douglas Corporation
P.O. Box 516
St. Louis, MO 63116
Dept. 257, Bldg. 102, M/C 1022152

St. Louis County Health Department
111 S. Meramec Avenue
Clayton, MO 63105

Global Environmental Laboratories
11040 Lin Valle
St. Louis, MO 63123

14.2   System Audits

System audits are conducted to measure Laboratory compliance to the written program. System audits evaluate Laboratory procedures for data recording, instrument logbooks, sample log-in, dispensing and labeling samples for analysis, updating QC criteria for spike recoveries, performance of in-house and out-of-house proficiency testing, and implementation of control charts. These audits may be conducted for total laboratory or partial laboratory in its scope. All final reports in the laboratory undergo a final QC/QA review. This review is performed to confirm that the project requirements were met, any conclusions were correctly derived, all necessary data are present with the package, and to check for errors in calculations, transcriptions, or formatting.

15.0   QC Data Evaluation and Corrective Action

Corrective actions at the quality control level are designed to "fix" problems before they go on for quality assurance review and reported to the client. It is the responsibility of all parties reviewing data prior to quality assurance to provide an explanation, in the form of raw data, written text, or otherwise, of why the data should be considered valid from the standpoint of accuracy, precision, and reproducibility. This allows the quality assurance function to focus on its purpose, specifically, to validate the data from the standpoint of traceability, defensibility, and completeness of documentation. The QA and QC functions must inherently work closely together for a total quality product, but their goals and requirements are clearly not the same.

Often there are quality control failures that are beyond the control of the analyst. For these instances, it is especially important that the analyst provide an explanation of why the data should be considered valid or how the failures may effect the validity of the data.

Corrective actions at the QA level are typically in one of two categories; immediate and on going. These are described in more detail below:

Immediate Corrective Actions – These minor and major problems can be corrected immediately. Examples include failure to date or sign a field form and errors in data entry. Corrective actions would include verbally calling attention to the problem followed by the signature or correction of data on the form.

On-Going Corrective Actions – These consist of minor and major problems that require a series of actions to resolve the problem. The actions to be taken may be coordinated by the immediate supervisor or the QA Coordinator and corrective action is used to track the correction.

Corrective actions must be documented and records kept of all out of control events, the determined cause or causes and corrective actions taken.

16.0   Quality Assurance Reports

The QA Coordinator shall prepare quarterly summaries of QA problems, corrective actions, and quality assurance audits.

The Quality Assurance coordinator shall conduct a quality assurance audit at least annually. The audit shall be documented and maintained in an accessible form.

The executive management shall conduct a review of the quality system and testing activities. While one person fills all management positions, the management review and annual quality assurance audit may be conducted simultaneously. However, at such time as reassignment of responsibility, the Laboratory Director must conduct a separate management review.

17.0   Document and Record Control

17.1   Document Control

Documents and records include, but are not limited to, test reports, client requests for analysis, notebooks, equipment manuals, test methods and regulations, and computer software. The Laboratory Director shall review and approve the documents and records for use at the Laboratory and periodically review the documents and records in use at the Laboratory. Invalid documents shall be removed and marked as obsolete. Any changes or revisions to the documents or records must be clearly marked, initialed and dated. Computer control shall be in accordance with Section 9.2, Computers, of this manual.

A master list shall be maintained that indicates the current authorized revision of all documents in the quality system. Staff members must review the master list to assure that a current revision is used as reference.

17.2   Control of Records

EnviroHealth Technologies "Test Reports" shall be bound with all documentation relevant to the client request of services for the project. The data packet should include copies of all pertinent communications, chain of custody, raw data, shipping and receiving records, test report, invoice, and copies of any computer generated data sheets. When more than one report is combined on computer printouts, a reference as to the location of the printout must be reference in the data packet for easy retrieval of information.

The data packets are filed alphabetically by client and segregated annually. All laboratory hard copy records shall be maintained for at least ten (10) years in an environment that will minimize deterioration and the possibility of loss. In the event that the Laboratory would go out of business, records of environmental lead analysis must be returned to the client.

Computer generated data information shall be printed and stored as a hard copy with the data packet. Computer records shall be controlled in accordance with Section 9.2, Computers, of this manual. In general, computer file backup tapes and disks shall be in duplicate with one copy available at the laboratory and the second to be archived at a designated area other than the laboratory.

18.0   Sample Retention and Disposal

Sample storage shall be in accordance with the EHT Laboratory Chemical Hygiene Plan and at a minimum federal, state, and local regulations. Samples shall be stored in appropriate containers. The storage area shall be reviewed on a regular basis to assess the current condition of stored samples.

Sample retention shall be a minimum of three (3) months and may be retained for extended periods of time upon client request. All disposals shall be appropriate for the waste generated and be in accordance with the Laboratory Chemical Hygiene Plan and federal, state, and local regulations.

The Quality Assurance Coordinator may select to retain stable samples for use in the Laboratory's internal quality control program.

After completion of asbestos analysis in bulk materials, the samples shall be either packaged for return to the client, or stored in the designated storage area in properly labeled 6 mil burial bags, or other appropriate container, for transport to an approved landfill for disposal no sooner than 30 days after completion of analysis. Temporary storage of samples in the Light Microscopy Laboratory before transfer to the designated storage area shall be in a covered container lined with a properly labeled 6 mil burial bag.

19.0   Subcontracting of Laboratory Services

Any laboratory selected for subcontracting of analysis shall be selected on the basis of competence and accreditation necessary for the work being subcontracted. EnviroHealth Technologies, Inc. client shall be informed verbally and in writing of the analysis to be subtracted and the laboratory selected. The subcontracted laboratory report attached to a cover letter from EHT shall be forwarded to the client.

Current copies of accreditation for subtracted laboratories shall be maintained at EnviroHealth Technologies while the laboratory remains on the approved list. In the event that an accreditation expires and the laboratory cannot submit a valid accreditation, that laboratory shall be excluded from the subcontracting list.

Subcontracting procedures must be in accordance with policies described in EnviroHealth Technologies' Standard Operating Procedure (SOP).

ENVIROHEALTH TECHNOLOGIES, INC.
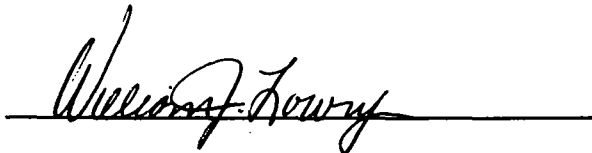
Standard Operating Procedure

EHT/SOP-IH011

Method for the Determination of Lead
In Wipe Samples

Approved by: May 18, 2001

(signature)   Date: _May 18, 2001_
                                                            November 1, 2001

William J. Lowry, CIH
Laboratory Director/Quality Assurance Coordinator

EnviroHealth Technologies, Inc.
Standard Operating Procedure

EHT/SOP-IH011

Method for the Determination of Lead
in Wipe samples

1.0 Scope

    1.1   This method is applicable to the analysis of Pb, which is collected on wipe samples. The samples are subjected to acid digestion and analyzed by Flame Atomic Absorption.

2.0 Summary of Method

    2.1   The wipes are prepared using concentrated (conc.) acids and hydrogen peroxide.

    2.2   The samples are diluted to 100 mL.

    2.3   The sample is aspirated into the flame of an atomic absorption spectrophotometer (AAS).

    2.4   The absorption is measured at the characteristic wavelength of lead.

    2.5   The absorption intensity is used to calculate the solution concentration of the analyte from a calibration curve. The total weight (μg) of lead on the wipe may be determined.

    2.6   From the appropriate data supplied by the collector, the concentration of lead on surface samples collected may be calculated in units of $\mu g/ft^2$.

3.0 Reagents

    3.1   All chemicals shall be reagent grade.

    3.2   DI water

    3.3   Concentrated Nitric Acid (HNO_3) Low Trace Metals Grade

    3.4   Concentrated Hydrochloric Acid (HCL) Low Trace Metals Grade

    3.5   30% Hydrogen Peroxide

PRECAUTION: Care must be exercised when handling any acidic solutions. Acid solution contact with work surfaces should be avoided. If any acid contacts the eyes, skin, or clothes, flush the area immediately with copious amounts of water. Medical treatment may be necessary. Always wear safety glasses and protective clothing. Prepare all mixtures, samples, or dilutions in an exhaust hood. To avoid exposure to acid vapors, do not remove any beakers from the hood until they have returned to room temperature.

    3.6   Calibration Standards

        3.6.1   Lead Stock Standards, 1000μg/mL

        3.6.2   Working Standards

3.6.2.1 Dilute stock standards to the appropriate ranges using a diluent that will match the sample matrix. The standard concentrations should bracket the expected sample concentrations and the standard/sample matrices should match. Store standards in appropriate containers. Routinely, the following standards will be made for the analysis: $1\mu g/mL$, $2\mu g/mL$, $4\mu g/mL$, $6\mu g/mL$, $8\mu g/mL$, and $10\mu g/mL$.

4.0 Equipment

4.1 Perkin-Elmer 5100PC Atomic Absorption Spectrophotometer
    4.1.1 Nebulizer and Burner head
    4.1.2 Pressure-regulating devices for maintaining constant oxidant and fuel pressures.
    4.1.3 Optical system for isolating the desired wavelength of radiation.
    4.1.4 Adjustable slit
    4.1.5 Light measuring and amplifying device
    4.1.6 Computer interface for indicating the amount of absorbed or emitted radiation.
    4.1.7 Deuterium Arc Background Corrector.
    4.1.8 Lead Hollow Cathode Lamp
    4.1.9 Oxidant, compressed, filtered air free from water, oils and other contaminants.
    4.1.10 Fuel
        4.1.10.1 Acetylene
    4.1.11 Pressure regulators, Two Stage
4.2 Glassware
    4.2.1 Assorted Beakers
    4.2.2 Assorted Volumetric Flasks
    4.2.3 Cover Glasses
    4.2.4 Glass Rods
    4.2.5 Graduated Cylinder
    4.2.6 Class A Pipettes
4.3 Miscellaneous Equipment
    4.3.1 Filter Apparatus
    4.3.2 Filter Paper-Whatman No. 41 or equivalent (11 cm)
    4.3.3 Hot plate
    4.3.4 Thermometer
    4.3.5 Funnels
    4.3.6 Micropipettors with Disposable Pipette Tips
    4.3.7 Vinyl Gloves - powderless

5.0 Glassware Preparation

5.1 Place the glassware in an exhaust hood and add approximately 10 mL of concentrated HNO_3 in each. Apply moderate heat until refluxing occurs. Decant the acid solution into a containment vessel and allow the glassware to cool. Rinse the glassware thoroughly with DI water.

6.0 Sample Preparation

6.1 Carefully remove wipe sample from Scintillation vial and place in the bottom of a beaker.

6.2   If the vial contains loose dust, carefully rinse the dust into the beaker with D.I. water. If necessary, wipe out the dust with a clean MCE filter and place this filter into the according sample beaker.

6.3   Submerge each wipe sample in 25 mL 1:1 HNO_3 conc. / D.I. water.
Note: A stir rod may be needed to push the sample into the acid.

6.4   Place the sample beakers on a hot plate and digest samples for approximately 15 minutes. Take sample off hot plate and allow to cool.

6.5   Pipette 10 ml of HNO_3 conc. to each sample beaker.

6.6   Place the sample beakers on a hot plate and digest samples until approximately 10 mL of solution remains. Take samples off hot plate and allow cooling.

6.7   Pipette 5 mL of D.I. water and 5 ml of 30% H_2O_2 conc. to each sample.

6.8   Place the sample beakers on a hot plate and digest samples until approximately 10 mL of solution remains. Take samples off hot plate and allow cooling.

6.9   Filtration

    6.9.1   If particulate is present in sample beakers, filter extract through a MCE filter into a 100 mL volumetric. Repeat digestion procedure to prepare the remaining insoluble material for addition analyses. To control potential contamination, prepare the blank sample(s) in the same fashion as the filtered samples.

    6.9.2   If particulate matter is present after digesting, cool the sample, add approximately 10 mL D.I. water and then filter the solution through a MCE filter into the appropriate 100 mL volumetric flask. Repeat digestion procedure again for the filter containing the particulate.

6.10   Dilution

    6.10.1   Wipe samples are normally diluted to 100-mL unless certain conditions suggest an alternate volume should be used. For routine analysis, 1/10 of the regulation limit should be detected.

7.0   Instrument Setup and Analysis

7.1   Setup the AAS according to the programmed method procedure and the manufacturer's instruction. Use the flame and wavelength settings programmed in the method procedure. If alternate conditions are necessary, consult the Laboratory Director prior to analysis. Install hollow cathode lamp for the lead and allow to warm up for 10-20 minutes or until the energy output stabilizes. Optimize conditions such as lamp position, burner head alignment, fuel and oxidant flow rates, etc

7.2   Aspirate and measure the absorbance (ABS) of a standard solution for lead. The standard concentration should be within the linear range for the element. Compare the ABS to an expected sensitivity value. Then aspirate the smallest standard to be used and assure the ABS reading is above the background level of the instrument.

7.3   Make any adjustments necessary for the particulate analysis, such as: scale expansion, burner head rotation, background correction, or alternate wavelength.

7.4   Aspirate and measure the ABS of a prepared standard solution, then determine the baseline by aspirating DI water and measuring the ABS.

7.5   Analyze standards, samples, and blanks. Repeat the baseline determination after each solution is analyzed. The baseline reading will

assist in correcting any instrument drift. Standards must bracket the sample concentration. Analyze a standard after every ten-sample readings. Standard reading should be within 10% of the reading obtained at the beginning of the analysis.

7.6   If any samples exceed the linear range, they should be diluted. When diluting a sample, be sure that the diluted sample has the same matrix as the original sample and standards. If a number of samples must be diluted, it may be more advantageous to use a less sensitive wavelength.

8.0   Calculations

$$C = (A \times SV \times D \times GF)/SA$$

C = Lead $\mu g/ft^2$
A = Concentration of Analyte in the sample solution ($\mu g/mL$)
D = Dilution Factor (if any)
GF = Gravimetric Factor (if any)
SA = Surface area of sample wipe (ft^2)
SV = Sample Volume (100 mL)

9.0   Quality Control

9.1   For each group of twenty (20) samples analyzed, a method blank (MB) must be analyzed. The method blank is digested with the same digestion solution made up in section 6 at the same time of samples. If any lead is detected in the MB at a concentration equal to or greater than the reporting detection limit for lead, no further analysis may be performed until the source of the contamination has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.2   For each group of twenty (20) samples analyzed, a standard spike (SP) must be analyzed. A SP sample is a method blank to which a known concentration of lead is added. SP's are prepared and analyzed analogously to a sample. If the percent recovery (%R) or relative percent difference (%RPD) for any analyte of interest is outside the limits of the control chart (see 9.5), no further analysis may be performed until the source of the QC failure has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.3   For each group of ten (10) analyses following initial calibration, a continuing calibration standard (CCV) must be analyzed. The CCV is a standard at a concentration near the mid-point of the calibration curve. If the value calculated for any analyte of interest is not within ± 10% of the true value, no further analysis may be performed until the source of the QC failure has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.4   Control Charts. Control charts are generated using spike recovery data points. A standard deviation (SD) value is calculated for the data points with respect to the mean value and integral units of the standard deviation. Warning limits are set at ± 2 SD; value outside ± 3 SD is

considered QC failure requiring reanalysis or explanation by the QA Coordinator.

9.5   Quality Assurance (QA) Review. All worksheets generated by the analyst must be reviewed, signed and dated by a supervisor or the QA Coordinator

Quality Control Sample Table

QC samples	Definitions	Frequency	Minimum Acceptable ELPAT Limits
Initial Calibration Blank (ICB)	A standard solution that contains no analyte and is used for initial calibration and zeroing instrument response.	Once at the beginning of run	Absolute value not more 10% of the regulatory limit or minimum level of concern
Method Blank (MB)	A blank soil sample carried through sample preparation along with the other samples. Should reflect the maximum treatment give to any one sample within the batch..	1 per 20 samples, a minimum of I per batch.	Absolute value not more 10% of the regulatory limit or minimum level of concern
Reagent Blank (CCB)	De-ionized water digest as a sample with addition of all reagents. Should reflect the maximum treatment given to any one sample within the batch	After each (CCV)	Absolute value not more 10% of the regulatory limit or minimum level of concern
Matrix Spike Sample	A blank fortified with lead before preparation	1 per 20 samples, a minimum of 1 per batch	Within ± 25% of the known value
Sample Duplicate	Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method.	1 per 20 samples, a minimum of 1 per batch	Within ± 25% of RPD
Independent Calibration Verification (ICV)	A standard solution used to verify calibration standard levels. Concentration of lead is near mid-range of the linear curve which is made from a stock solution having a different manufacturer or manufacturer lot identification than the calibration std.	Once per run after calibration	Within ± 10% of the known value
Continuing Calibration Verification (CCV)	A standard solution used to verify freedom of excessive instrument drift. The CCV should be matrix match and near the mid-range of curve.	Before and at the end of each run as well as every 10 samples.	Within ± 10% of the known value
Reference Material (LCS)	A material of known composition where the manufacturer certifies the lead level.	1 per 20 samples or 5% of batch	Within ± 20% of the known value

10.0   References

10.1   ASTM E 1644

ENVIROHEALTH TECHNOLOGIES, INC.

Standard Operating Procedure

EHT/SOP-IH010

Method of the Determination of Lead
Contained in Paint Samples

Approved by: May 14, 2001

_____   Date: _May 14, 2001_
William J. Lowry, CIH   _November 1, 2001_
Laboratory Director/Quality Assurance Coordinator

ENVIROHEALTH TECHNOLOGIES, Inc.
Standard Operating Procedure

EHT/SOP-IH010

Method of the Determination of Lead
Contained in Paint Samples

1.0   Scope
  1.1   This procedure covers the sample preparation and the analysis of lead in paint chips.

2.0   Summary of Method
  2.1   The paint sample is prepared using concentrated (conc.) acids and 30 % hydrogen peroxide.
  2.2   The sample solution is diluted to a known volume.
  2.3   The sample is aspirated into the flame of an Atomic Absorption Spectrometer (AAS).
  2.4   The absorption of light is measured at the characteristic wavelength for lead.
  2.5   The absorption intensity is used to calculate the solution concentration of lead from a calibration curve. The total weight of lead in the paint may be determined.
  2.6   The concentration of the lead in the paint samples may be calculated in units of percent by weight or weight per unit area.

3.0   Reagents
  3.1   Deionized water
  3.2   30% Hydrogen Peroxide, Reagent Grade
  3.3   Nitric Acid, (conc.) Redistilled, Low Trace Metals
  PRECAUTION: Care must be exercised when handling any acidic solutions. Acid solution contact with work surfaces should be avoided. If any acid contacts the eyes, skin, or clothes, flush the area immediately with copious amounts of water. Medical treatment may be necessary. Always wear safety glasses and protective clothing. Prepare all mixtures, samples, or dilutions in an exhaust hood. To avoid exposure to acid vapors, do not remove any beakers from the hood until they have returned to room temperature.
  3.5   Calibration Standards
      3.5.1   Lead Stock Standards, 1000μg/mL
      3.5.2   Working Standards
          3.5.2.1 Dilute stock standards to the appropriate ranges using a diluent that will match the sample matrix. The standard concentrations should bracket the expected sample concentrations and the standard/sample matrices should match. Store standards in appropriate containers. Routinely the following standards will be made for analysis; 1.0μg/mL, 2.5μg/mL, 5.0μg/mL, 10.0μg/mL, 20.0μg/mL, and 30.0μg/mL.

4.0   Equipment
4.1 Perkin-Elmer 5100PC Atomic Absorption Spectrophotometer
   4.1.1 Nebulizer and Burner head
   4.1.2 Pressure-regulating devices for maintaining constant oxidant and fuel pressures.
   4.1.3 Optical system for isolating the desired wavelength of radiation.
   4.1.4 Adjustable slit
   4.1.5 Light measuring and amplifying device
   4.1.6 Computer interface for indicating the amount of absorbed or emitted radiation.
   4.1.7 Deuterium Arc Background Corrector.
   4.1.8 Hollow Cathode Lamps
   4.1.9 Oxidant, compressed, filtered air free from water, oils and other contaminants.
   4.1.10 Acetylene, AA Grade
   4.1.11 Pressure regulators, Two Stage
  4.2 Analytical Balance – accurate to the nearest 0.0001 gram.
  4.3 Miscellaneous Glassware
   4.3.1 Assorted Beakers
   4.3.2 Assorted Volumetric Flasks
   4.3.3 Cover Glasses
   4.3.4 Glass Rods
   4.3.5 Graduated Cylinder
   4.3.6 Class A Pipettes
  4.4 Miscellaneous Equipment
   4.4.1 Filter Apparatus
   4.4.2 Filter Paper-Whatman No. 41 or equivalent (11 cm)
   4.4.3 Hot plate
   4.4.4 Thermometer
   4.4.5 Funnels
   4.4.6 Micropipettors with Disposable Pipette Tips
   4.4.7 Vinyl Gloves - powderless

5   Glassware Preparation
  5.1 Place the glassware in an exhaust hood and add approximately 10 mL of concentrated HNO_3 in each. Apply moderate heat until refluxing occurs. Decant the acid solution into a containment vessel and allow the glassware to cool. Rinse the glassware thoroughly with DI water.

6   Sample Preparation
  6.1 Measure the weight of each paint sample to the nearest 0.0001 gram. The sample weight should be approximately 0.20 grams.
   6.1.1 Remove any large amounts of substrate present in the sample before weighing sample. Excessive care should be taken when removing substrate to avoid any paint sample lose. If required, use a clean safety razor blade or equivalent tool to aid in substrate removal.
  6.2 Homogenizing Paint Samples
   6.2.1 Break up the paint sample into small pieces using a clean sharp blade or crushing with a clean glass rod. The sample should be

broken done to a powder. **Note:** The use of a mortar and pestle may be needed to achieve a powder.

6.3 Place each paint sample into an oven for at least two hours at a temperature setting of 105 °C. This will dry the sample before weighing.

6.4 Measure the weight of the vessel that the paint sample will be weighed. Tare analytical balance after the scale has stabilized. Put approximately 0.2 grams of dried paint in the vessel and record weight to the nearest 0.0001 grams.

6.5 Place paint sample into a 100 ml beaker and add the digestion solution (3 mL HNO_3 and 1 mL of 30% H_2O_2). Cover sample with a watch glass. Heat hot plate to a surface temperature of approximately 140°C and place sample on hot plate surface. Heat samples until approximately 1 mL. Then remove sample from heat and allow cooling.

6.6 Repeat step 6.5 digesting 2mL concentrated HNO_3 and 1mL 30% H_2O_2. Heat sample until approximately 1 mL. Allow sample to cool.

6.7 Repeat step 6.6 until the paint is digested to completion. Digested sample color is a good indicator. Digested sample appearance should remain unchanged.

6.8 Add 1 mL of concentrated HNO_3 and swirl sample.

6.9 Rinse beaker walls and watch glass with D.I. water into beaker and dilute the sample solution into a 25 mL volumetric flask.

6.10 Remove any particulate in digestate by filtration with a MCE Whatman 41 filter or equivalent.

7.0 Instrument Setup and Analysis

7.1 Setup the AAS according to the programmed method procedure and the manufacturer's instruction. Use the flame and wavelength settings programmed in the method procedure. If alternate conditions are necessary, consult the Laboratory Director prior to analysis. Install the lead hollow cathode and allow warming for 10-20 minutes or until the energy output stabilizes. Optimize conditions such as lamp position, burner head alignment, fuel and oxidant flow rates, etc.

7.2 Aspirate and measure the absorbance (ABS) of a standard solution for lead. The standard concentration should be within the linear range of lead. Compare the ABS to an expected sensitivity value. Then aspirate the smallest standard to be used and assure the ABS reading is above the background level of the instrument.

7.3 Make any adjustments necessary for the particulate analysis, such as: scale expansion, burner head rotation, background correction, or alternate wavelength.

7.4 Aspirate and measure the ABS of a prepared standard solution, then determine the baseline by aspirating DI water and measuring the ABS.

7.5 Analyze standards, blanks, and samples. Repeat the baseline determination after each solution is analyzed. The baseline reading will assist in correcting any instrument drift. Standards must bracket the sample concentration. Analyze a standard after every ten-sample reading. Standard reading should be within 10% of the reading obtained at the beginning of the analysis.

7.6 If any samples exceed the linear range, they should be diluted. When diluting a sample, be sure that the diluted sample has the same matrix as

the original sample and standards. If a number of samples must be
diluted, it may be more advantageous to use a less sensitive wavelength.

8.0   Calculations

$$C = [((A)(B)(D))/(1000)][(E)/(F)]/(G)$$

C = concentration in mg/cm^2
A = measured lead in sample digest, (µg/mL)
B = final digested volume, (mL)
D = additional dilution factors from instrument measurement
E = total collected sample mass, (g)
F = mass of sample digestion for lead measurement, (g)
G = area of collected sample, (cm^2)

$$C = ((A)(B)(D)(1000))/(E)$$

C = Percent Lead by weight
A = measured lead in sample digest, (µg/mL)
B = final digested volume, (mL)
D = additional dilution factors from instrument measurement
E = total collected sample mass, (mg)

9.0   Quality Control

9.1   All required Quality Control (QC) is indicated on the quality control sample
table. Any QC failures must be communicated to the Quality Assurance
Coordinator immediately. No further analysis may be preformed until the
source of the QC failure has been determined and corrected, or has been
evaluated by the Quality Assurance Coordinator as having significant
effect upon the analytical results.

9.2   Control Charts. Control charts are generated using quality control data.
A standard deviation (SD) value is calculated for the data points with
respect to the mean value and integral units of the standard deviation.
Warning limits are set at ± 2 SD; value outside ± 3 SD is considered QC
failure requiring reanalysis or explanation by the QA Coordinator.

9.5   Quality Assurance (QA) Review. All worksheets generated by the analyst
must be reviewed, signed and dated by a supervisor or the QA
Coordinator.

Quality Control Sample Table

QC samples	Definitions	Frequency	Minimum Acceptable ELPAT Limits
Initial Calibration Blank (ICB)	A standard solution that contains no analyte and is used for initial calibration and zeroing instrument response.	Once at the beginning of run	Absolute value not more 10% of the regulatory limit or minimum level of concern
Method Blank (MB)	A blank sample carried through sample preparation along with the other samples. Should reflect the	1 per 20 samples, a minimum of I per batch.	Absolute value not more 10% of the regulatory

	maximum treatment give to any one sample within the batch.		limit or minimum level of concern
Reagent Blank (CCB)	De-ionized water digest as a sample with addition of all reagents. Should reflect the maximum treatment given to any one sample within the batch	After each (CCV)	Absolute value not more 10% of the regulatory limit or minimum level of concern
Matrix Spike Sample (MS)	A blank fortified with lead before preparation	1 per 20 samples, a minimum of 1 per batch	Within ± 25% of the known value
Sample Duplicate (SD)	Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method.	1 per 20 samples, a minimum of 1 per batch	Within ± 25% of RPD
Independent Calibration Verification (ICV)	A standard solution used to verify calibration standard levels. Concentration of lead is near mid-range of the linear curve which is made from a stock solution having a different manufacturer or manufacturer lot identification than the calibration std.	Once per run after calibration	Within ± 10% of the known value
Continuing Calibration Verification (CCV)	A standard solution used to verify freedom of excessive instrument drift. The CCV should be matrix match and near the mid-range of curve.	Before and at the end of each run as well as every 10 samples.	Within ± 10% of the known value
Reference Material (LCS)	A material of known composition where the manufacturer certifies the lead level.	1 per 20 samples or 5% of batch	Within ± 20% of the known value
Reporting Limit Matrix Spike (RLMS)	A matrix spike fortified with a lead concentration equal to or below the stated reporting limit.	Once per run after calibration	Within ± 20% of the known value

10.0   References

10.1   ASTM E 1645 - 94
10.2   OSHA ID - 121

ENVIROHEALTH TECHNOLOGIES, INC.
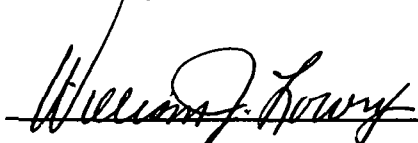
Standard Operating Procedure

EHT/SOP-IH012

Method for the Determination of Lead
In Sediment, Sludge and Soil

Approved by: May 23, 2001

William J. Lowry

William J. Lowry, CIH
Laboratory Director/Quality Assurance Coordinator

Date: _May 23, 2001_
November 1, 2001

ENVIROHEALTH TECHNOLOGIES, Inc.
Standard Operating Procedure

EHT/SOP-IH012

Method for the Determination of Lead
in Sediment, Sludge and Soil

1.0 Scope
This method is applicable to the analysis of lead, which is contained in Sediment, Sludge and Soil samples by flame atomic absorption spectrometer.

2.0 Summary of Method
2.1 For the digestion of samples, a representative 1-2 gram wet sample or 1 gram dry sample is needed. The digestion will be done with nitric acid and peroxide solution added repeatedly.
2.2 If required, a separate sample aliquot shall be dried for total percent solid determination.
2.3 The digested samples will be analyzed by flame atomic absorption spectrometer (AAS).

3.0 Reagent
3.1 All chemicals shall be reagent grade.
3.2 DI water
3.3 Concentrated Nitric Acid (HNO_3) Low Trace Metals Grade
3.4 30% Hydrogen Peroxide, Reagent Grade
PRECAUTION: Care must be exercised when handling any acidic solutions. Acid solution contact with work surfaces should be avoided. If any acid contacts the eyes, skin, or clothes, flush the area immediately with copious amounts of water. Medical treatment may be necessary. Always wear safety glasses and protective clothing. Prepare all mixtures, samples, or dilutions in an exhaust hood. To avoid exposure to acid vapors, do not remove any beakers from the hood until they have returned to room temperature.
3.5 Calibration Standards
    3.5.1 Lead Stock Standards, 1000µg/mL
    3.5.2 Working Standards
        3.5.2.1 Dilute stock standards to the appropriate ranges using a diluent that will match the sample matrix. The standard concentrations should bracket the expected sample concentrations and the standard/sample matrices should match. Store standards in appropriate containers. Routinely, the following standards will be made for lead determination; 1µg/mL, 2 µg/mL, 4 µg/mL, 6 µg/mL, 8 µg/mL, and 10 µg/mL.

4.0 Equipment
4.1 Perkin-Elmer 5100PC Atomic Absorption Spectrophotometer

    4.1.1 Nebulizer and Burner head

    4.1.2 Pressure-regulating devices for maintaining constant oxidant and fuel pressures.

    4.1.3 Optical system for isolating the desired wavelength of radiation.

    4.1.4 Adjustable slit

    4.1.5 Light measuring and amplifying device

    4.1.6 Computer interface for indicating the amount of absorbed or emitted radiation.

    4.1.7 Deuterium Arc Background Corrector.

    4.1.8 Lead Hollow Cathode Lamp

    4.1.9 Oxidant, compressed, filtered air free from water, oils and other contaminants.

    4.1.10 Fuel, Acetylene, AA Grade

    4.1.11 *Pressure regulators, Two Stage*

4.2   Analytical balance – accurate to the nearest 0.0001 gram

4.3   Glassware

    4.3.1 Assorted Beakers

    4.3.2 Assorted Volumetric Flasks

    4.3.3 Cover Glasses

    4.3.4 Graduated Cylinder

4.4   Miscellaneous Equipment

    4.4.1 Filter Apparatus

    4.4.2 Filter Paper - Whatman No. 41 or equivalent (11 cm MCE)

    4.4.3 Hot plate

    4.4.4 Drying Oven

    4.4.5 Mortar and Pestle

    4.4.6 Thermometer

    4.4.7 Plastic gloves – powder less

    4.4.8 Micropipettes with Disposable Pipette Tips

    4.4.9 Sieves

5.0 Glassware Preparation

5.1   Place the glassware in an exhaust hood and add approximately 10 mL of Concentrated HNO_3 in each. Apply moderate heat until refluxing occurs. Decant the acid solution into a containment vessel and allow the glassware to cool. Rinse the glassware thoroughly with DI water.

6.0 Sample Preparation

6.1   Mix the sample thoroughly to achieve homogeneity.

6.2   Weigh a 1-2 gram sample for wet materials or 0.75 ± 0.05 gram for dry sludge. Transfer each sample into a clean and dry petri dish and cover with a watch glass. Place in a drying oven set at $100 \pm 10°C$ for a minimum of 6 hours. After drying, place into desiccator to cool to room temperature.

6.3   Weigh samples again if % water needs to be determined. Then weigh 0.75 ± 0.05 gram sample for lead determination.

6.4   All samples must be weighed to the nearest 0.0001-gram. Put contents in beakers.

6.5   Place 3 mL HNO_3 and 1 mL of 30% H_2O_2 and cover with a watch glass. Heat hotplate to an approximate surface temperature of 140 degrees C.

and place all samples on the hotplate. Ash samples to approximately 1 mL. Then remove samples from heat and allow cooling.

6.6 Repeat step 6.5 digesting with 2 mL concentrated HNO_3 and 1 mL of 30% H_2O_2. Ash samples to approximately 1 mL. Allow samples to cool.

6.7 Repeat step 6.6 until the soil sample is digested to completion. Digested sample color is a good indicator. Digested sample appearance should remain unchanged.

6.8 Add 1 mL of concentrated HNO_3 and swirl sample.

6.9 Dilute samples into 25 mL volumetric flasks.

6.10 Remove any particulate in digestate by filtration with a MCE Whatman 41 filter or equivalent.

6.11 Analyze samples by Atomic Absorption.

7.0 Instrument Setup and Analysis

7.1 Setup the AAS according to the programmed method procedure and the manufacturer's instruction. Use the flame and wavelength settings programmed in the method procedure. If alternate conditions are necessary, consult the Laboratory Director prior to analysis. Install lead hollow cathode lamp and allow warming for 10-20 minutes or until the energy output stabilizes. Optimize conditions such as lamp position, burner head alignment, fuel and oxidant flow rates, etc.

7.2 Aspirate and measure the absorbance (ABS) of a standard solution for lead. The standard concentration should be within the linear range of lead. Compare the ABS to an expected sensitivity value. Then aspirate the smallest standard to be used and assure the ABS reading is above the background level of the instrument.

7.3 Make any adjustments necessary for the particulate analysis, such as: scale expansion, burner head rotation, background correction, or alternate wavelength.

7.4 Aspirate and measure the ABS of a prepared standard solution, then determine the baseline by aspirating DI water and measuring the ABS.

7.5 Analyze standards, blanks and samples. Repeat the baseline determination after each solution is analyzed. The baseline reading will assist in correcting any instrument drift. Standards must bracket the sample concentration. Analyze a standard after every ten-sample readings. Standard reading should be within 10% of the reading obtained at the beginning of the analysis.

7.6 If any samples exceed the linear range, they should be diluted. When diluting a sample, be sure that the diluted sample has the same matrix as the original sample and standards. If a number of samples must be diluted, it may be more advantageous to use a less sensitive wavelength.

8.0 Calculations

8.1 The concentrations determined are to be reported on the actual weight of the sample.

$$C = (A \times SA \times D \times GF)/(SM \times 1000)$$

C = in units of mg/Kg
A = Concentration of analyte in the sample solution (µg/mL)
SA = Sample solution volume (mL)

D = Dilution factor (if any)
GF = Gravimetric factor (if any)
SM = Sample Mass Digested (Kg)

9.0 Quality Control

9.1   All required Quality Control (QC) is indicated on the table.   Any QC failures must be communicated to the Quality Assurance Coordinator immediately. No further analysis may be preformed until the source of the QC failure has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having significant effect upon the analytical results.

9.2   Control Charts. Control charts are generated using the quality control data. A standard   deviation (SD) value is calculated for the data points with respect to the mean value and integral units of the standard deviation. Warning limits are set at ± 2 SD; value outside ± 3 SD is considered QC failure requiring reanalysis or explanation by the QA Coordinator.

9.3   Quality Assurance (QA) Review. All worksheets generated by the analyst must be reviewed, signed and dated by a supervisor or the QA Coordinator.

Quality Control Sample Table

QC samples	Definitions	Frequency	Minimum Acceptable ELPAT Limits
Initial Calibration Blank (ICB)	A standard solution that contains no analyte and is used for initial calibration and zeroing instrument response.	Once at the beginning of run	Absolute value not more 10% of the regulatory limit or minimum level of concern
Method Blank (MB)	A blank sample carried through sample preparation along with the other samples. Should reflect the maximum treatment give to any one sample within the batch..	1 per 20 samples, a minimum of I per batch.	Absolute value not more 10% of the regulatory limit or minimum level of concern
Reagent Blank (CCB)	De-ionized water digest as a sample with addition of all reagents. Should reflect the maximum treatment given to any one sample within the batch	After each (CCV)	Absolute value not more 10% of the regulatory limit or minimum level of concern
Matrix Spike Sample (MS)	A blank fortified with lead before preparation	1 per 20 samples, a minimum of 1 per batch	Within ± 25% of the known value
Sample Duplicate (SD)	Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method.	1 per 20 samples, a minimum of 1 per batch	Within ± 25% of RPD
Independent Calibration Verification (ICV)	A standard solution used to verify calibration standard levels. Concentration of lead is near mid-range of the linear curve which is made from a stock solution having a different manufacturer or manufacturer lot identification than the calibration std.	Once per run after calibration	Within ± 10% of the known value
Continuing Calibration	A standard solution used to verify freedom of excessive instrument	Before and at the end of	Within ± 10% of the

Verification (CCV)	drift. The CCV should be matrix match and near the mid-range of curve.	each run as well as every 10 samples.	known value
Reference Material (LCS)	A material of known composition where the manufacturer certifies the lead level.	1 per 20 samples or 5% of batch	Within ± 20% of the known value
Reporting Limit Matrix Spike (RLMS)	A matrix spike fortified with a lead concentration equal to or below the stated reporting limit.	Once per run after calibration	Within ± 20% of the known value

10.0   References

10.1   NIOSH 7082
10.2   OSHA ID-121
10.3   ASTM E1726-95

ENVIROHEALTH TECHNOLOGIES, INC.

Standard Operating Procedure

EHT/SOP-IH007

Measurement of Metal Analytes in Air
Collected on Mixed Cellulose Ester Membranes

Approved by:

June 21, 1999
Rev. 1, December 15, 2000

_____ Date: _December 15, 2000_
November 1, 2001

William J. Lowry, CIH
Laboratory Director/Quality Assurance Coordinator

EnviroHealth Technologies, Inc.
Standard Operating Procedure

EHT/SOP-IH007

Measurement of Metal Analytes in Air
Collected on Mixed Cellulose Ester Membranes

1.0   Scope

1.1   This method is applicable to the analysis of metal analytes which may be collected from air on 37 mm mixed cellulose ester (MCE) membranes in cassette assemblies, desorbed or digested using water extractions or mineral acid digestions, and analyzed by flame atomic absorption or emission spectroscopy (FAAS or FAES). The following metals may be analyzed using this procedure.

Aluminum (Al)	Gold (Au)	Potassium (K)
Antimony (Sb)	Indium (In)	Selenium (Se)
Barium (Ba)	Iron (Fe)	Silver (Ag)
Bismuth (Bi)	Lead (Pb)	Sodium (Na)
Cadmium (Cd)	Lithium (Li)	Tellurium (Te)
Calcium (Ca)	Magnesium (Mg)	Thallium Tl)
Cesium (Cs)	Manganese (Mn)	Tin (Sn)
Chromium (Cr)	Molybdenum (Mo)	Titanium (Ti)
Cobalt (Co)	Nickel (Ni)	Yttrium (Y)
Copper (Cu)	Platinum (Pt)	Zinc (Zn)

2.0   Summary of Method

2.1   The cassette membrane is prepared using concentrated (Conc.) acids or extracted with deionized water if a soluble fraction is required.

2.2   The sample solution is diluted to a known volume after any necessary matrix modifiers are added.

2.3   The sample is aspirated into the flame of an atomic absorption or emission spectrophotometer (AAS or AES).

2.4   The absorption or emission of light is measured at the characteristic wavelength of the element of interest.

2.5   The absorption or emission intensity is used to calculate the solution concentration of the analyte from a calibration curve. The total weight, in mg or μg, of analyte on the membrane may be determined.

2.6   If appropriate data is available, the concentration of the analyte in the air sample collected may be calculated in units of mg/m^3 or $\mu g/m^3$.

3.0   Reagents

3.1   Deionized water

3.2   Hydrogen peroxide (30%), ACS

3.3   Hydrochloric acid, conc., Redistilled

3.4   Nitric acid, conc. Redistilled

3.5   Sulfuric acid, conc. Redistilled

PRECAUTION: Care must be exercised when handling any acidic solutions. Acid solution contact with work surfaces should be avoided. If any acid contacts the eyes, skin, or clothes, flush the area immediately with copious amounts of water. Medical treatment may be necessary. Always wear safety glasses and protective clothing. Prepare all mixtures, samples, or dilutions in an exhaust hood. To avoid exposure to acid vapors, do not remove any beakers from the hood until they have returned to room temperature.

3.6   Chemical or ionization interference suppressants

       3.6.1   Aluminum nitrate, ACS, 5,000 µg/mL: Dissolve 69.52 g aluminum nitrate $(AL(NO_3)_3 \bullet 9H_2O)$ and dilute to 1 L in DI H2O.

       3.6.2   Potassium chloride, ACS, 5,000 mg/mL: Dissolve 9.54 g potassium chloride (KCl) in DI H_2O and dilute to 1 L.

       3.6.3   Sodium chloride, ACS, 5,000 µg/mL: Dissolve 12.71 g sodium chloride (NaCl) in DI H_2O and dilute to 1 L.

3.7   Calibration Standards

       3.7.1   Stock Standards, 1000 µg/mL (ppm)

       3.7.2   Working Standards

             3.7.2.1   Dilute stock standard solutions to the appropriate ranges using a diluent that will match the sample matrix. The standard concentrations should bracket the expected sample concentrations and the standard/sample matrices should match.

       3.7.2.2 Store standards in appropriate containers.

4.0   Equipment

     4.1   Perkin-Elmer 5100PC Atomic Absorption Spectrophotometer

       4.1.1   Nebulizer and burner head

       4.1.2   Pressure-regulating devices for maintaining constant oxidant and fuel pressures

       4.1.3   Optical system for isolating the desired wavelength of radiation

       4.1.4   Adjustable slit

       4.1.5   Light measuring and amplifying device

       4.1.6   Computer interface for indicating the amount of absorbed or emitted radiation.

       4.1.7   Deuterium Arc Background Corrector

       4.1.8   Hollow cathode lamps

       4.1.9   Oxidant, compressed, filtered air free from water, oils and other contaminants.

       4.1.10 Nitrous oxide

       4.1.11 Fuel

             4.1.11.1   Acetylene

             4.1.11.2   Hydrogen

       4.1.12 Pressure regulators, Two-stage

       4.1.13 Flash arrestors

     4.2   Glassware

       4.2.1   Beakers, 50-mL

       4.2.2   Cover glasses

4.2.3 Volumetric Flasks, Assorted sizes

4.2.4 Pipettes, Class A: Assorted sizes

4.3 Analytical balance (0.01mg).

4.4 Filtering apparatus consisting of MCE filters, 0.45-μm pore size, 47-mm diameter and filtering apparatus.

5.0 Glassware Preparation

5.1 Place the beakers in an exhaust hood and add approximately 10 mL of a 1:1 HNO_3/DI H_2O mixture in each. Apply moderate heat until refluxing occurs. Decant the acid mixture into a waste container and allow the beakers to cool before removing from the hood. Rinse the beakers thoroughly with DI H_2O.

6.0 Sample Preparation

6.1 Carefully remove the membrane from the cassette and place in the bottom of a 50-mL beaker.

6.1.1 If the cassette contains loose dust, carefully rinse the dust into the beaker with DI H_2O. If necessary, wipe out the dust with a clean MCE filter and place this filter in the sample beaker.

6.1.2 If the backup pad appears to be discolored, it may be due to leakage of air around the filter during sampling. In these cases, the pad should also be prepared and analyzed. Place the backup pad in a separate beaker.

6.2 Determine the reagents used during extraction or digestion from the table below for each element to be analyzed.

SUBSTANCE	Reference Paragraph	REAGENTS USED	FINAL VOLUME CONCENTRATION
Ag	6.4	HNO_3/HCl	4% HNO_3/16% HCl
Al (soluble cmpds)	6.5	DI H_2O	4% HNO_3/1,000 μg/mL K^+
Al (pyro powders)	6.6	HNO_3	4% HNO_3/1,000 μg/mL K^+
Au	6.7	HCl/HNO_3	10% HCl
Ba (soluble cmpds)	6.5	DI H_2O	4% HNO_3/1,000 μg/mL K^+
Bi_3Te_3 (Se doped)	6.3	HNO_3	4 % HNO_3
Ca & cmpds	6.6	HNO_3/HCl*	4% HNO_3/1,000 μg/mL K^+
Cd	6.3	HNO_3	4 % HNO_3
Co & cmpds	6.3	HNO_3/HCl*	4 % HNO_3
Cr (II or III) soluble cmpds	6.5	DI H_2O	4 % HNO_3
Cr metal	6.8	HNO_3/H_2O_2/HCl*	4 % HNO_3
CsOH	6.9	DI H_2O	DI H_2O /1,000 μg/mL K^+
Cu	6.3	HNO_3	4 % HNO_3
Fe & cmpds	6.3	HNO_3/HCl*	4 % HNO_3
Fe (soluble salts)	6.5	DI H_2O	4 % HNO_3
In & cmpds	6.3	HNO_3	4 % HNO_3
KOH	6.9	DI H_2O	DI H_2O /1,000 μg/mL Na^+
LiH	6.9	DI H_2O	DI H_2O
MgO	6.6	HNO_3/HCl*	4% HNO_3/1,000 μg/mL K^+
Mn & cmpds	6.3	HNO_3/HCl*	4 % HNO_3
Mo (soluble cmpds)	6.5	DI H_2O	4% HNO_3/1,000 μg/mL Al
Mo (insoluble cmpds)	6.6	HNO_3	4% HNO_3/1,000 μg/mL Al
Na & cmpds	6.9	DI H_2O	DI H_2O
Ni metal & insoluble cmpds	6.3	HNO_3/HCl*	4 % HNO_3
Ni (soluble cmpds)	6.5	DI H_2O	4 % HNO_3
Pb	6.4	HNO_3/HCl	4% HNO_3/16% HCl

Pt	6.7	HCl/HNO_3	4% HNO_3/16% HCl
Sb & cmpds	6.4	HNO_3/HCl	4% HNO_3/32% HCl
Se & cmpds	6.4	HNO_3/HCl	4% HNO_3/4% HCl
Sn (and SnO)	6.7	HCl/HNO_3	10% HCl
Te & cmpds	6.4	HNO_3/HCl	4% HNO_3/4% HCl
TiO_3	6.10	HNO_3/H_2SO_4	4% H_2SO_4/1,000 µg/mL K^+
Tl (soluble cmpds)	6.5	DI H_2O	4 % HNO_3
Y	6.6	HNO_3	4% HNO_3/1,000 µg/mL K^+
$ZnCl_2$	6.5	DI H_2O	4 % HNO_3
Zn & cmpds	6.3	HNO_3	4 % HNO_3

* After completing the digestion with HNO3, add 1 or 2 drops of conc. HCl to facilitate particulate dissolution.

6.3 Bi_3Te_3 (Se doped), Cd, Co & cmpds, Cu, Fe & cmpds, In & cmpds, Mn & cmpds, Ni metal & insoluble cmpds, Zn & cmpds

         6.3.1   Add 3 to 5 mL conc. HNO_3 to cover the filter. Place the beakers on a hot plate and heat the samples until about 1 mL remains. Add a second portion of approximately 1 to 2 mL of conc. HNO_3. Heat until the appropriate amount of HNO_3 remains in the beaker (1 mL of HNO_3 will give a 4% HNO_3 matrix when diluted to 25 mL final volume).

6.4   Ag, Pb, Sb, Se, Te

         6.4.1   Digest samples with HNO_3. Heat until the liquid is nearly gone. Allow the samples to cool to room temperature.

         6.4.2   For 25 mL final sample solution volumes, add the following amount of conc. HCl (Adjust accordingly for alternate solution volumes):

             Sb   8 mL
             Pb or Ag   4 mL
             Se or Te   1 mL

         6.4.3   Warm gently and swirl to dissolve the analyte. Allow samples to cool and dilute to 25-mL volume with DI H_2O.

6.5   Soluble compounds of Al, Ba, Cr (II or III), Fe, Mo, Ni, Mo, Zn

         6.5.1   Add aliquot of room temperature DI H_2O in beaker (15 mL is typically used for a full-shift sample).

         6.5.2   Place beaker in an ultrasonic bath for approximately 10 minutes.

         6.5.3   Filter the sample through a 0.45-µm MCE filter and transfer the filtrate to a 25-mL volumetric flask. If an insoluble fraction is also requested, digest sample filters according to the appropriate procedure.

         6.5.4   Add reagents to achieve the final solution concentrations listed:

             Cr (II or III), Fe, Ni, Tl, Zn (as ZnCl2)   4% HNO_3
             Al, Ba   4% HNO_3/1,0000µg/mL K+
             Mo   4% HNO_3/1,000µg/mL Al+

6.6   Al (pyro powders), Ca, Mg, Mo (insoluble), Y

         6.6.1   Digest the sample using the procedure described in Paragraph 6.3

         6.6.2   Transfer to a volumetric flask.

         6.6.3   Dilute the samples and add ionization suppressants to achieve the final solution concentrations listed:

             Al (pyro powders), Ca, Mg, Y   4% HNO_3/1,000 µg/mL K+

Mo (insoluble)   4% HNO_3/1,000µg/mL Al+

6.7   Au, Pt (metal), Sn, or Tin Oxide (SnO)

    6.7.1   Add 9 mL HCl to each beaker, swirl, and add 2 mL HNO_3. **Caution: Make sure the entire filter or sample is wetted with HCl and allow the filter/HCl solution to sit for a period of at least 2 to 3 minutes before adding the HNO_3.**

    6.7.2   Digest the sample on a hot plate until nearly dry.

    6.7.3   Allow the samples to cool and then quantitatively transfer the sample, using a small amount of DI H_2O to rinse the beaker, to a clean volumetric flask. Dilute to volume, making the final solution 10% HCl. For example, add 2.5-mL conc. HCl to a sample if the total solution volume is 25 mL.

    6.7.4   Result for either Sn or SnO is reported as total Sn.

6.8   Cr [Samples that potentially contain Cr (IV)] Note: The following procedure should be used for analysis of total Cr. This procedure avoids the loss of any Cr (VI) as chromyl chloride (CrO_2Cl_2).

    6.8.1   Digest the samples with HNO_3 and then allow to cool to room temperature,

    6.8.2   Add 1 or 2 mL of 30% H_2O_2 to the cooled solution to reduce any Cr (VI) that may be present. Let stand for several minutes.

    6.8.3   Heat approximately 5 minutes to boil off the H_2O_2 and allow cooling. At this stage HCl may be added if needed to dissolve other metals.

    6.8.4   Dilute to volume with DI H_2O and analyze.

6.9   CsOH, KOH LiH, and Na Compounds

    6.9.1   Desorb filter with 15 mL of DI H_2O for approximately 5 minutes.

    6.9.2   Decant the sample solution into a 25-mL volumetric flask and add any reagents to achieve the final solution concentrations:

CsOH	DI H_2O /1,000 µg/mL K+
LiH, Na cmpds	DI H_2O
KOH	DI H_2O /1,000 µg/mL Na+

For example, add 5 mL of 5,000 µg/mL potassium ion for Cs analysis and dilute to volume with DI H_2O. Add 5 mL of 5,000 µg/mL sodium ion for KOH analysis.

    6.9.3   Analyze by flame emission or atomic absorption.

6.10   Titanium Dioxide

    6.10.1   Digest with 1 mL HNO_3 and 2 mL H_2SO_4 in a Phillips beaker and heat until about 1 mL remains.

    6.10.2   Quantitatively transfer solution to a 25-mL volumetric flask, add 5 mL of 5,000 µg/mL potassium ion, then dilute to volume with DI H_2O.

6.11   Filtration

    6.11.1   Samples extracted with DI H_2O should normally be filtered. If particulate is present, filter the extract through a 0.45-µm MCE filter. Save the filtrate. Repeat appropriate digestion procedure to prepare the remaining insoluble material for additional analyses. To control for potential contamination, prepare blank samples in the same fashion as the filtered samples.

    6.11.2   If particulate matter is present after digesting, cool the sample, add approximately 10 mL DI H_2O, and then filter the solution through a 0.45-

μm MCE filter. Save the filtrate. Repeat digestion procedure 6.3 above for the filter containing the particulate.

6.12 Dilution

6.12.1 Air samples are normally diluted to 25-mL unless certain conditions suggest an alternate volume should be used. For routine analysis, at least 1/10 of the OSHA PEL should be detectable.

7.0 Instrument Setup and Analysis

7.1 Set up the AAS or AES according to the programmed method procedure and the manufacturer's instruction. Use the flame and wavelength settings programmed in the method procedure. If alternate conditions are necessary, consult the Laboratory Director prior to analysis. Install the hollow cathode lamp for the element of interest and allow to warm up for 10-20 minutes or until the energy output stabilizes. Optimize conditions such as lamp position, burner head alignment, fuel and oxidant flow rates, etc.

7.2 Aspirate and measure the ABS of a standard solution for the element of interest. The standard concentration should be within the linear range for the element. Compare the ABS to an expected sensitivity value. Then aspirate the smallest standard to be used and assure the ABS reading is above the background level of the instrument.

7.3 Make any adjustments necessary for the particular analysis, such as: scale expansion, burner head rotation, background correction, or alternate wavelength.

7.4 Aspirate and measure the ABS of a prepared standard solution, then determine the baseline by aspirating DI H_2O and measuring the ABS.

7.5 Analyze standards, samples, and blanks. Repeat the baseline determination after each solution is analyzed. The baseline readings will assist in correcting any instrument drift. If more than one solution has been prepared for a sample, analyze each for all requested elements. Standards must bracket the sample concentrations. Analyze a standard after every four or five samples. Standard readings should be within 10 to 15% of the readings obtained at the beginning of the analysis

7.6 If any samples exceed the linear range, they should be diluted. When diluting a sample, be sure that the diluted sample has the same matrix as the original sample and standards. If a number of samples must be diluted, it may be more advantageous to use a less sensitive wavelength.

8.0 Calculations

8.1 Subtract each baseline ABS from the corresponding standard ABS, and plot the net ABS versus the standard concentrations. Using a least squares method, determine the equation for the best curve fit.

8.2 Subtract each baseline ABS from the corresponding sample or blank ABS, and use the standard curve to calculate the concentration of each analyte in μg/mL.

8.3 Calculate the concentration for each air sample as:

$$C = \frac{[(A \times SA \times D \times GF) - (B \times SB \times GF)]}{AV}$$

Where:

C = analyte (mg/m^3)
A = concentration of analyte in the sample solution (μg/mL)
B = concentration of analyte in the blank solution (μg/mL)
SA = Sample solution volume (mL)
SB = blank solution volume (mL)
D = dilution factor (if any)
GF = gravimetric factor (if any)
AV = air volume sampled (L)

9.0 Quality Control

9.1 For each group of ten- (10) samples analyzed, a method blank (MB) must be analyzed. The MB is an unused filter membrane that has been prepared and analyzed in the same manner as a sample. The MB should be of the same lot as the filter membrane used for sampling. If any analyte of interest is detected in the MB at a concentration equal to or greater than the reporting detection limit for the analyte, no further analysis may be performed until the source of the contamination has been determine and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.2 For each group of ten- (10) samples analyzed, a standard spike (SP) must be analyzed. A SP is a filter membrane to which has been added a known concentration of one or more analytes of interest. SP's are prepared and analyzed analogously to a sample, and should be of the same lot as the filter membrane used for sampling. If the percent recovery (%R) or relative percent difference (%RPD) for any analyte of interest is outside the limits of the control chart (see 9.5), no further analysis may be performed until the source of the QC failure has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.3 For each batch of analyses, a calibration verification standard (CVS) prepared independently from a source other than that of the calibration standards shall be used to verify that the instrument calibration is within the acceptance criteria. An acceptance criterion of ± 10% of the theoretical value shall be used until the Laboratory can obtain sufficient data to establish internal limits. If the CVS value is outside the acceptance criteria, no further analysis may be performed until the source of the QC failure has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.4 For each group of ten- (10) analyses following initial calibration, a continuing calibration standard (CCV) must be analyzed. The CCV is a standard at a concentration near the mid-point of the calibration curve. If the value calculated for any analyte of interest is not within ± 10% of the true value, no further analysis may be performed until the source of the QC failure has been determined and corrected, or has been evaluated by the Quality Assurance Coordinator as having no significant effect upon the analytical results.

9.5 Control Charts. Control charts are generated using spike recovery data points. A standard deviation (SD) value is calculated for the data point set, with the chart describing the statistical distribution of the data points with respect to the mean value and integral units of the standard deviation. Warning limits are set at ± 2

SD; values outside ± 3 SD are considered QC failures requiring reanalysis or explanation by the QA Coordinator.

9.6   Quality Assurance (QA) Review. All worksheets generated by the analyst must be reviewed, signed, and dated by a supervisor or the QA Coordinator.

10.0   References
  10.1   OSHA Method ID-121
  10.2   NIOSH 7013
  10.3   NIOSH 7020
  10.4   NIOSH 7024
  10.5   NIOSH 7027
  10.6   NIOSH 7029
  10.7   NIOSH 7048
  10.8   NIOSH 7056
  10.9   NIOSH 7082

AIHA

The Essential Source

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD. SUITE 123
ST. LOUIS MO 63108

LabID# 102959

Dear WILLIAM LOWRY CIH:

Enclosed are your Environmental Lead Proficiency Analytical Testing (ELPAT) Round 37 results.

ELPAT Round 38 sample kits will be mailed to laboratories around February 1, 2002.
Results will be due at AIHA on March 1, 2002.

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888

Your Password to enter data via the Internet is now included on the submission form that is included with the ELPAT samples. Your password is in the upper left-hand corner (next to your lab ID#) of the mailing address label. Please do not call AIHA for your password. Because of security concerns, passwords will not be given over the phone.

Please note: After submitting your data on the ELPAT data web site, it is very important to print the confirmation page. Save this page as verification that results have been submitted.

The address to enter ELPAT results is: **http://www.aiha.org/proftest.htm**

The AIHA Laboratory Quality Assurance Programs, Policies and Application for AIHA accreditation are available on-line.
http://www.aiha.org

Note: The Policies for 2001 comply with ISO 17025.

The application covers the following programs:
1. Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

Fred I. Grunder

Fred I. Grunder, CIH

ENVIRONMENTAL LEAD PROFICIENCY ANALYTICAL TESTING (ELPAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 037
LAB ID=102959   DECEMBER 7, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

SAMPLE TYPE	SAMPLE NO.	REPORTED RESULTS	REFERENCE VALUES *	ACCEPTABLE RANGE # LOWER	UPPER	LAB @ PERFORMANCE	Z & SCORE
Paint Chips (%)	1	1.422	1.5683	1.2163	1.9203	A	-1.25
	2	3.354	3.4275	2.8562	3.9988	A	-0.39
	3	0.6454	0.6779	0.523	0.8328	A	-0.63
	4	0.0425	0.0465	0.0338	0.0591	A	-0.95
Soil (mg/kg)	1	626.6	644	520.4	767.6	A	-0.42
	2	315	316.5	236.3	396.8	A	-0.06
	3	92.7	92.8	62.3	123.3	A	-0.01
	4	164.2	176	134.3	217.7	A	-0.85
Dust Wipes (ug)	1	22	16.9368	6.1	27.7	A	1.41
	2	282.1	260.793	179.9	341.7	A	0.79
	3	550.7	564.6684	425.2	704.2	A	-0.30
	4	47	49.1123	30.5	67.7	A	-0.34

```
* Reference value is the mean of the reference laboratories
# Upper limit: reference value + 3 standard deviations
  Lower limit: reference value - 3 standard deviations
@ A: Analysis acceptable;   -: Results not reported
  H: Results > upper limit, L: Results < lower limit, not acceptable
& Z Score = (reported result-reference value)/standard deviation
Note: the acceptablity of reported results is based on z-scores.
      This is why a reported result may appear acceptable according to
      performance limits, but be identified as an outlier.
```

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LABORATORY YEAR-TO-DATE PERFORMANCE REPORT
LAB ID=102959

SAMPLE TYPE	ROUND NO.	ROUND * PERFORMANCE	ACCUMULATED 4 ROUNDS(%)		PERFORMANCE 2 ROUNDS(%)		PROFICIENCY RATING #
Paint Chips (%)	034	4/4					
	035	4/4					
	036	3/4					
	037	4/4	15/16	93	7/8	87	P
Soil (mg/kg)	034	4/4					
	035	4/4					
	036	4/4					
	037	4/4	16/16	100	8/8	100	P
Dust Wipes (ug)	034	4/4					
	035	4/4					
	036	4/4					
	037	4/4	16/16	100	8/8	100	P

```
* The denominators represent the total number of samples analyzed.
  The numerators represent the number of acceptable results.
# P : Proficient               NP: Nonproficient
  Performance ratings are based on accumulated results over four rounds
  (one year).  A lab's performance in ground paint chips, soil, or dust
  wipes is rated proficient (P), if: 1) three-fourths (75%) or more of the
  accumulated results over four rounds are acceptable or 2) for the last
  two rounds, all samples are analyzed and the results are 100 % acceptable.
  If a lab receives samples and does not report the data, the results will
  be treated as outliers.
```

AIHA

The Essential Source

September 10, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD. SUITE 123
ST. LOUIS MO 63108

LabID# 102959

Dear WILLIAM LOWRY CIH:

Enclosed are your Environmental Lead Proficiency Analytical Testing (ELPAT) Round 36 results.

ELPAT Round 37 sample kits will be mailed to laboratories around November 1, 2001.
Results will be due at AIHA on December 3, 2001.

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888

Your Password to enter data via the Internet is now included on the submission form that is included with the ELPAT samples. Your password is in the upper left-hand corner (next to your lab ID#) of the mailing address label. Please do not call AIHA for your password. Because of security concerns, passwords will not be given over the phone.

Please note: After submitting your data on the ELPAT data web site, it is very important to print the confirmation page. Save this page as verification that results have been submitted.

The address to enter ELPAT results is: **http://www.aiha.org/proftest.htm**

The AIHA Laboratory Quality Assurance Programs, Policies and Application for AIHA accreditation are available on-line.
http://www.aiha.org

Note: The Policies for 2001 comply with ISO 17025.

The application covers the following programs:
1. Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

Fred I. Grunder, CIH

SAMPLE TYPE	SAMPLE NO.	REPORTED RESULTS	REFERENCE VALUES *	ACCEPTABLE RANGE # LOWER	UPPER	LAB @ PERFORMANCE	Z & SCORE
Paint Chips (%)	1	1.476	1.5576	1.2763	1.8389	A	-0.87
	2	3.346	3.2953	2.6385	3.9521	A	0.23
	3	0.06	0.0598	0.0429	0.0767	A	0.03
	4	0.582	0.2851	0.2373	0.3329	H	9.00
Soil (mg/kg)	1	118.4	113.1	76.3	150	A	0.43
	2	148.2	141.9	104.1	179.8	A	0.50
	3	832.9	791.7	647.9	935.5	A	0.86
	4	302.2	289.5	215.7	363.3	A	0.52
Dust Wipes (ug)	1	177	162.255	119.2	205.3	A	1.03
	2	19.2	17.6325	7.4	27.9	A	0.46
	3	446	418.1217	326	510.3	A	0.91
	4	56.9	48.9833	31.3	66.7	A	1.35

```
* Reference value is the mean of the reference laboratories
# Upper limit: reference value + 3 standard deviations
  Lower limit: reference value - 3 standard deviations
@ A: Analysis acceptable;   -: Results not reported
  H: Results > upper limit, L: Results < lower limit, not acceptable
& Z Score = (reported result-reference value)/standard deviation
Note: the acceptablity of reported results is based on z-scores.
  This is why a reported result may appear acceptable according to
  performance limits, but be identified as an outlier.
```

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SAMPLE TYPE	ROUND NO.	ROUND * PERFORMANCE	ACCUMULATED 4 ROUNDS(%)		PERFORMANCE 2 ROUNDS(%)		PROFICIENCY RATING #
Paint Chips (%)	033	4/4					
	034	4/4					
	035	4/4					
	036	3/4	15/16	93	7/8	87	P
Soil (mg/kg)	033	4/4					
	034	4/4					
	035	4/4					
	036	4/4	16/16	100	8/8	100	P
Dust Wipes (ug)	033	4/4					
	034	4/4					
	035	4/4					
	036	4/4	16/16	100	8/8	100	P

```
* The denominators represent the total number of samples analyzed.
  The numerators represent the number of acceptable results.
# P : Proficient                    NP: Nonproficient
  Performance ratings are based on accumulated results over four rounds
  (one year).  A lab's performance in ground paint chips, soil, or dust
  wipes is rated proficient (P), if: 1) three-fourths (75%) or more of the
  accumulated results over four rounds are acceptable or 2) for the last
  two rounds, all samples are analyzed and the results are 100 % acceptable.
  If a lab receives samples and does not report the data, the results will
  be treated as outliers.
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June 11, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD.
SUITE 123
ST. LOUIS MO 63108

LabID# 102959

Dear WILLIAM LOWRY CIH:

Enclosed are your Environmental Lead Proficiency Analytical Testing (ELPAT) Round 35 results.

ELPAT Round 36 sample kits will be mailed to laboratories around August 1, 2001.
Results will be due at AIHA on September 4, 2001.

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888

Your Password to enter data via the Internet is now included on the submission form that is included with the ELPAT samples. Your password is in the upper left-hand corner (next to your lab ID#) of the mailing address label. Please do not call AIHA for your password. Because of security concerns, passwords will not be given over the phone.

Please note: After submitting your data on the ELPAT data web site, it is very important to print the confirmation page. Save this page as verification that results have been submitted.

The address to enter ELPAT results is: **http://www.aiha.org/proftest.htm**

The AIHA Laboratory Quality Assurance Programs, Policies and Application for AIHA accreditation are available on-line.
http://www.aiha.org

Note: The Policies for 2001 comply with ISO 17025.

The application covers the following programs:
1. Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

[signature]

Fred I. Grunder, CIH

American Industrial Hygiene Association
2700 Prosperity Ave., Suite 250, Fairfax, VA 22031
(703) 849-8888 (703) 207-8558 fax
InfoFax Service Line (703) 641-INFO or Internet: infonet@aiha.org

ENVIRONMENTAL LEAD PROFICIENCY ANALYTICAL TESTING (ELPAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 035
LAB ID=102959   JUNE 12, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

SAMPLE TYPE	SAMPLE NO.	REPORTED RESULTS	REFERENCE VALUES *	ACCEPTABLE RANGE # LOWER	UPPER	LAB @ PERFORMANCE	Z & SCORE
Paint Chips (%)	1	0.468	0.4632	0.3845	0.5419	A	0.18
	2	1.327	1.2898	1.0852	1.4944	A	0.55
	3	4.689	4.5403	3.7378	5.3427	A	0.56
	4	0.149	0.1394	0.1104	0.1684	A	0.99
Soil (mg/kg)	1	1077.5	1056.9	867.8	1246	A	0.33
	2	107	107.2	78.2	136.3	A	-0.03
	3	277.4	265.1	198.4	331.7	A	0.56
	4	589.6	570.7	437.8	703.6	A	0.43
Dust Wipes (ug)	1	96.7	87.9814	62.7	113.2	A	1.04
	2	604	561.8754	438.6	685.2	A	1.03
	3	279.9	256.7475	179.7	333.8	A	0.90
	4	42.1	41.5025	26.4	56.6	A	0.12

```
* Reference value is the mean of the reference laboratories
# Upper limit: reference value + 3 standard deviations
  Lower limit: reference value - 3 standard deviations
@ A: Analysis acceptable;   -: Results not reported
  H: Results > upper limit, L: Results < lower limit, not acceptable
& Z Score = (reported result-reference value)/standard deviation
Note: the acceptablity of reported results is based on z-scores.
      This is why a reported result may appear acceptable according to
      performance limits, but be identified as an outlier.
```

LABORATORY YEAR-TO-DATE PERFORMANCE REPORT
LAB ID=102959

SAMPLE TYPE	ROUND NO.	ROUND * PERFORMANCE	ACCUMULATED 4 ROUNDS(%)		PERFORMANCE 2 ROUNDS(%)		PROFICIENCY RATING #
Paint Chips (%)	033	4/4					
	034	4/4					
	035	4/4	12/12	100	8/8	100	P
Soil (mg/kg)	033	4/4					
	034	4/4					
	035	4/4	12/12	100	8/8	100	P
Dust Wipes (ug)	033	4/4					
	034	4/4					
	035	4/4	12/12	100	8/8	100	P

```
* The denominators represent the total number of samples analyzed.
  The numerators represent the number of acceptable results.
# P : Proficient                  NP: Nonproficient
  Performance ratings are based on accumulated results over four rounds
  (one year).  A lab's performance in ground paint chips, soil, or dust
  wipes is rated proficient (P), if: 1) three-fourths (75%) or more of the
  accumulated results over four rounds are acceptable or 2) for the last
  two rounds, all samples are analyzed and the results are 100 % acceptable.
  If a lab receives samples and does not report the data, the results will
  be treated as outliers.
```

AIHA

The Essential Source

March 9, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD.
SUITE 123
ST. LOUIS MO 63108

LabID# 102959

Dear WILLIAM LOWRY CIH:

Enclosed are your ELPAT Round 34 results.

ELPAT Round 35 sample kits will be mailed to laboratories around May 1, 2001.
Results will be due at AIHA on June 1, 2001.

Please note: After submitting your data on the ELPAT data web site, it is very important to print the confirmation page. Save this page as verification that results have been submitted.

The address to enter ELPAT results is: **http://www.aiha.org/proftest.htm**

The AIHA Laboratory Quality Assurance Programs, Policies and Application for AIHA accreditation are available on-line.
http://www.aiha.org

Note: The Policies for 2001 comply with ISO 17025.

The application covers the following programs:
1. Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

[signature]

Fred I. Grunder, CIH

ENVIRONMENTAL LEAD PROFICIENCY ANALYTICAL TESTING (ELPAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 034
LAB ID=102959   MARCH 9, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

SAMPLE TYPE	SAMPLE NO.	REPORTED RESULTS	REFERENCE VALUES *	ACCEPTABLE RANGE # LOWER	ACCEPTABLE RANGE # UPPER	LAB @ PERFORMANCE	Z & SCORE
Paint Chips (%)	1	1.333	1.3296	1.106	1.5531	A	0.05
	2	3.065	2.936	2.3798	3.4921	A	0.70
	3	5.1295	5.494	4.5412	6.4468	A	-1.15
	4	0.073	0.0761	0.0583	0.0939	A	-0.52
Soil (mg/kg)	1	148.5	139.2	105.2	173.2	A	0.82
	2	34.7	29	8.6	49.3	A	0.85
	3	639.3	659.8	556.1	763.5	A	-0.59
	4	129	114.1	81.5	146.8	A	1.37
Dust Wipes (ug)	1	107.2	117.0008	86.6	147.4	A	-0.97
	2	358.4	408.6593	288.2	529.1	A	-1.25
	3	54.2	41.2686	25.6	56.9	A	2.49
	4	238.4	201.5695	150.5	252.6	A	2.17

```
    * Reference value is the mean of the reference laboratories
    # Upper limit: reference value + 3 standard deviations
      Lower limit: reference value - 3 standard deviations
    @ A: Analysis acceptable;   -: Results not reported
      H: Results > upper limit, L: Results < lower limit, not acceptable
    & Z Score = (reported result-reference value)/standard deviation
 Note: the acceptablity of reported results is based on z-scores.
       This is why a reported result may appear acceptable according to
       performance limits, but be identified as an outlier.
```

LABORATORY YEAR-TO-DATE PERFORMANCE REPORT
LAB ID=102959

SAMPLE TYPE	ROUND NO.	ROUND * PERFORMANCE	ACCUMULATED 4 ROUNDS(%)		PERFORMANCE 2 ROUNDS(%)		PROFICIENCY RATING #
Paint Chips (%)	033	4/4					
	034	4/4	8/8	100	8/8	100	P
Soil (mg/kg)	033	4/4					
	034	4/4	8/8	100	8/8	100	P
Dust Wipes (ug)	033	4/4					
	034	4/4	8/8	100	8/8	100	P

```
    * The denominators represent the total number of samples analyzed.
      The numerators represent the number of acceptable results.
    # P : Proficient              NP: Nonproficient
      Performance ratings are based on accumulated results over four rounds
      (one year).  A lab's performance in ground paint chips, soil, or dust
      wipes is rated proficient (P), if: 1) three-fourths (75%) or more of the
      accumulated results over four rounds are acceptable or 2) for the last
      two rounds, all samples are analyzed and the results are 100 % acceptable.
      If a lab receives samples and does not report the data, the results will
      be treated as outliers.
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![AIHA logo] **AIHA**
The Essential Source

November 14, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD. SUITE 123
ST. LOUIS MO 63108

Lab ID# 102959

Dear WILLIAM LOWRY CIH

Enclosed are your Proficiency Analytical Testing (PAT) Round 147 results.

PAT Round 148 sample kits will be mailed to laboratories around January 2, 2002.
Results will be due to AIHA on February 1, 2002. The analytes for round 148 are:

Metals	**- cadmium, chromium, lead**
Organics	**- ethyl acetate (EAC), n-butyl acetate (BAC), 2-propanol (IPA)**
Asbestos	**- amosite (one manmade fiber)**

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888.

**Your Password to enter data via the internet is now included on the submission form included
with the PAT samples. Your password is in the upper left hand corner (next to your lab ID#) of the
mailing address label. Please do not call AIHA for your password. Because of security concerns,
passwords will not be given over the phone.**

Please note: After submitting your data on the PAT data web site, it is very important to print the
confirmation page. Save this page as verification that results have been submitted.

The address to enter PAT results is: **http://www.aiha.org/proftest.htm**

**The AIHA Laboratory Quality Assurance Programs, Policies and Application for AIHA
accreditation are available on-line**.
http://www.aiha.org

Note: The Policies for 2001 comply with ISO 17025.

The application covers the following programs:
1. Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

Fred J Grunder

Fred Grunder, CIH

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 147
LAB ID=102959   NOVEMBER 14, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

CONTAMINANT (ABV.)	UNIT	SAMPLE NO.	REPORTED RESULTS	MEAN VALUES *	ACCEPTABLE RANGE# LOWER	UPPER	Z & SCORE	LAB ⓐ PERFORMANCE
CADMIUM (CAD)	(MG)	1	0.0057	0.0058	0.0050	0.0067	-0.40	A
	(MG)	2	0.0147	0.0143	0.0125	0.0161	0.62	A
	(MG)	3	0.0029	0.0029	0.0024	0.0034	0.05	A
	(MG)	4	0.0076	0.0076	0.0066	0.0086	0.02	A
LEAD (LEA)	(MG)	1	0.0970	0.0975	0.0858	0.1092	-0.13	A
	(MG)	2	0.0477	0.0485	0.0423	0.0548	-0.40	A
	(MG)	3	0.0739	0.0730	0.0642	0.0818	0.32	A
	(MG)	4	0.0241	0.0243	0.0206	0.0280	-0.13	A
ZINC (ZIN)	(MG)	1	0.0961	0.0983	0.0841	0.1124	-0.46	A
	(MG)	2	0.0449	0.0490	0.0410	0.0570	-1.53	A
	(MG)	3	0.0879	0.0785	0.0668	0.0902	2.40	A
	(MG)	4	0.1458	0.1461	0.1261	0.1661	-0.04	A
ASBESTOS/FIBERS (ASB/MMF)	(F/MM2)	1	272.0000	262.4194	128.5855	443.4888	0.18	A
	(F/MM2)	2	137.0000	175.3595	85.9261	296.3575	-1.16	A
	(F/MM2)	3	252.0000	291.0146	142.5972	491.8147	-0.69	A
	(F/MM2)	4	75.0000	74.3600	36.4364	125.6684	0.04	A
CHLOROFORM (CFM)	(MG)	1	0.5836	0.5791	0.4989	0.6593	0.17	A
	(MG)	2	0.2925	0.2909	0.2443	0.3376	0.10	A
	(MG)	3	0.8026	0.7695	0.6676	0.8714	0.97	A
	(MG)	4	0.1932	0.1879	0.1538	0.2220	0.47	A
1,2-DICHLOROETHANE (DCE)	(MG)	1	0.5876	0.5750	0.5011	0.6488	0.51	A
	(MG)	2	0.7813	0.7753	0.6770	0.8736	0.18	A
	(MG)	3	0.4107	0.3853	0.3346	0.4359	1.51	A
	(MG)	4	1.0082	0.9504	0.8307	1.0701	1.45	A
TRICHLOROETHYLENE (TCE)	(MG)	1	0.4517	0.4508	0.3914	0.5102	0.04	A
	(MG)	2	0.3618	0.3649	0.3159	0.4140	-0.19	A
	(MG)	3	0.9020	0.8723	0.7623	0.9823	0.81	A
	(MG)	4	0.2022	0.1893	0.1615	0.2171	1.39	A

* Mean values are the mean of all laboratories based on original scales except for asbestos.
  Asbestos results are calculated based on transformed data. Therefore, asbestos performance limits are
  not symmetrical to the mean values.
Upper limit: mean value + 3 standard deviations
  Lower limit: mean value - 3 standard deviations
& Z Score = (reported result-mean value)/standard deviation
ⓐ A: Analysis acceptable   -: Results not reported
  H: Results > upper limit (Z > 3), not acceptable   L: Results < lower limit (Z < -3), not acceptable
Note: the acceptability of reported results is based on z-scores. This is why a reported result may appear
  acceptable according to performance limits, but be identified as an outlier.

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
LABORATORY <mark>YEAR-TO-DATE PERFORMANCE REPORT FOR ROUND 147</mark>
LAB ID=102959   NOVEMBER 14, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

SAMPLE TYPE	ROUND	ROUND * PERFORMANCE	ACCUMULATED PERFORMANCE 4 ROUNDS (%)		2 ROUNDS (%)		PROFICIENCY RATING #
METALS	144	12/12					
	145	12/12					
	146	12/12					
	147	12/12	48/48	100	24/24	100	P
ASBESTOS/FIBERS	144	4/4					
	145	3/4					
	146	4/4					
	147	4/4	15/16	94	8/8	100	P
ORGANICS	144	4/4					
	145	12/12					
	146	7/8					
	147	12/12	35/36	97	19/20	95	P

* The denominators represent the total number of samples to be analyzed.
  The numerators represent the number of acceptable results.
  A '-' represents non-submittal and is calculated as a zero in the numerator.
P : Proficient   N: Nonproficient
  Performance ratings are based on expected results over four rounds (one year).   A lab's
  performance on each sample type is rated proficient (P), if: 1) three-fourths   (75%) or more
  of the accumulated results over four rounds are acceptable or 2) for the   last two rounds,
  all samples are analyzed and the results are 100% acceptable. If a   laboratory receives
  samples for a contaminant and does not report the data, the results will be   considered
  unacceptable for that contaminant.

AIHA
The Essential Source

August 6, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD.
SUITE 123
ST. LOUIS MO 63108

Lab ID# 102959

Dear WILLIAM LOWRY CIH

Enclosed are your Proficiency Analytical Testing (PAT) Round 146 results.

PAT Round 147 sample kits will be mailed to laboratories around October 1, 2001.
Results will be due to AIHA on November 1, 2001. The analytes for round 147 are:

Metals - **cadmium, lead, zinc**
Organics - **chloroform (CFM), 1,1,1-trichloroethane (MCM), trichloroethylene (TCE)**
Asbestos - **chrysotile (one manmade fiber)**

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888.

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with the PAT samples. Your password is in the upper left hand corner (next to your lab ID#) of the
mailing address label. Please do not call AIHA for your password. Because of security concerns,
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accreditation are available on-line.**
http://www.aiha.org

Note: The Policies for 2001 comply with ISO 17025.

The application covers the following programs:
1. Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

Fred Grunder, CIH

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 146
LAB ID=102959   AUGUST 3, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

CONTAMINANT (ABV.)	UNIT	SAMPLE NO.	REPORTED RESULTS	MEAN VALUES *	ACCEPTABLE RANGE# LOWER	UPPER	Z & SCORE	LAB @ PERFORMANCE
CADMIUM (CAD)	(MG)	1	0.0170	0.0174	0.0152	0.0195	-0.50	A
	(MG)	2	0.0087	0.0086	0.0075	0.0098	0.22	A
	(MG)	3	0.0065	0.0058	0.0049	0.0066	2.63	A
	(MG)	4	0.0098	0.0096	0.0083	0.0108	0.53	A
CHROMIUM (CHR)	(MG)	1	0.0612	0.0613	0.0510	0.0716	-0.03	A
	(MG)	2	0.2228	0.2171	0.1782	0.2561	0.44	A
	(MG)	3	0.0815	0.0799	0.0663	0.0934	0.36	A
	(MG)	4	0.1430	0.1411	0.1166	0.1657	0.23	A
LEAD (LEA)	(MG)	1	0.0819	0.0778	0.0685	0.0872	1.31	A
	(MG)	2	0.1032	0.0971	0.0855	0.1088	1.57	A
	(MG)	3	0.0603	0.0584	0.0511	0.0657	0.78	A
	(MG)	4	0.0286	0.0298	0.0255	0.0341	-0.81	A
ASBESTOS/FIBERS (ASB/MMF)	(F/MM2)	1	296.0000	242.6766	129.5965	390.9365	1.16	A
	(F/MM2)	2	480.0000	407.4888	233.5441	629.5360	1.05	A
	(F/MM2)	3	176.0000	189.9585	96.8768	314.0866	-0.39	A
	(F/MM2)	4	106.0000	96.5835	47.3259	163.2261	0.48	A
METHYL ETHYL KETONE(MEK)	(MG)	1	0.3691	0.4257	0.3414	0.5100	-2.01	A
	(MG)	2	0.5433	0.7022	0.5713	0.8332	-3.64	L
	(MG)	3	0.1510	0.1630	0.1240	0.2020	-0.92	A
	(MG)	4	0.3003	0.3266	0.2592	0.3940	-1.17	A
METHYL ISOBUT KETONE (MIK)	(MG)	1	0.4268	0.4611	0.3708	0.5513	-1.14	A
	(MG)	2	0.6004	0.6387	0.5185	0.7590	-0.96	A
	(MG)	3	0.0801	0.0913	0.0654	0.1171	-1.29	A
	(MG)	4	0.2725	0.2822	0.2224	0.3420	-0.49	A

* Mean values are the mean of all laboratories based on original scales except for asbestos.
  Asbestos results are calculated based on transformed data. Therefore, asbestos performance limits are
  not symmetrical to the mean values.
Upper limit: mean value + 3 standard deviations
  Lower limit: mean value - 3 standard deviations
& Z Score = (reported result-mean value)/standard deviation
@ A: Analysis acceptable   -: Results not reported
  H: Results > upper limit (Z > 3), not acceptable   L: Results < lower limit (Z < -3), not acceptable
Note: the acceptability of reported results is based on z-scores. This is why a reported result may appear
  acceptable according to performance limits, but be identified as an outlier.

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
LABORATORY <mark>YEAR-TO-DATE PERFORMANCE REPORT FOR ROUND 146</mark>
LAB ID=102959   AUGUST 3, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

| SAMPLE TYPE | ROUND | ROUND * PERFORMANCE | ACCUMULATED PERFORMANCE | | | | PROFICIENCY RATING # |
			4 ROUNDS (%)		2 ROUNDS (%)		
METALS	143	12/12					
	144	12/12					
	145	12/12					
	146	12/12	48/48	100	24/24	100	P
ASBESTOS/FIBERS	143	4/4					
	144	4/4					
	145	3/4					
	146	4/4	15/16	94	7/8	88	P
ORGANICS	143	12/12					
	144	4/4					
	145	12/12					
	146	7/8	35/36	97	19/20	95	P

* The denominators represent the total number of samples to be analyzed.
  The numerators represent the number of acceptable results.
  A '-' represents non-submittal and is calculated as a zero in the numerator.
P : Proficient   N: Nonproficient
  Performance ratings are based on expected results over four rounds (one year).   A lab's
  performance on each sample type is rated proficient (P), if: 1) three-fourths   (75%) or more
  of the accumulated results over four rounds are acceptable or 2) for the   last two rounds,
  all samples are analyzed and the results are 100% acceptable. If a   laboratory receives
  samples for a contaminant and does not report the data, the results will be   considered
  unacceptable for that contaminant.

AIHA

The Essential Source

May 14, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD.
SUITE 123
ST. LOUIS MO 63108

Lab ID# 102959

Dear WILLIAM LOWRY CIH

Enclosed are your Proficiency Analytical Testing (PAT) Round 145 results.

PAT Round 146 sample kits will be mailed to laboratories around July 1, 2001.
Results will be due to AIHA on August 1, 2001. The analytes for round 146 are:

Metals	-	**cadmium, chromium, lead**
Organics	-	**methyl ethyl ketone (MEK), methyl isobutyl ketone (MIK)**
Asbestos	-	**amosite (one manmade fiber)**

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888.

**Your Password to enter data via the internet is now included on the submission form included
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2. Environmental Lead Laboratory Accreditation Program (ELLAP)
3. Asbestos Analysts Registry (AAR)
4. Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

Fred J Grunder

Fred Grunder, CIH

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 145
LAB ID=102959   MAY 14, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

CONTAMINANT (ABV.)	UNIT	SAMPLE NO.	REPORTED RESULTS	MEAN VALUES *	ACCEPTABLE RANGE# LOWER	UPPER	Z & SCORE	LAB @ PERFORMANCE
CADMIUM (CAD)	(MG)	1	0.0198	0.0190	0.0167	0.0213	1.09	A
	(MG)	2	0.0151	0.0143	0.0125	0.0160	1.42	A
	(MG)	3	0.0084	0.0077	0.0066	0.0087	2.08	A
	(MG)	4	0.0032	0.0029	0.0024	0.0034	1.66	A
LEAD (LEA)	(MG)	1	0.0980	0.0967	0.0851	0.1083	0.33	A
	(MG)	2	0.0894	0.0875	0.0770	0.0979	0.56	A
	(MG)	3	0.0255	0.0243	0.0206	0.0280	0.97	A
	(MG)	4	0.0500	0.0484	0.0422	0.0547	0.74	A
ZINC (ZIN)	(MG)	1	0.1951	0.1939	0.1682	0.2197	0.14	A
	(MG)	2	0.1491	0.1461	0.1262	0.1661	0.44	A
	(MG)	3	0.1020	0.0979	0.0838	0.1120	0.87	A
	(MG)	4	0.0558	0.0492	0.0411	0.0572	2.48	A
ASBESTOS/FIBERS (ASB/MMF)	(F/MM2)	1	283.0000	251.9750	123.4677	425.8377	0.60	A
	(F/MM2)	2	170.0000	138.5834	67.9059	234.2060	1.08	A
	(F/MM2)	3	377.0000	201.7532	98.8591	340.9629	3.67	H
	(F/MM2)	4	126.0000	121.6350	59.6012	205.5632	0.18	A
BENZENE (BNZ)	(MG)	1	0.0724	0.0747	0.0591	0.0903	-0.44	A
	(MG)	2	0.1133	0.1186	0.0976	0.1396	-0.76	A
	(MG)	3	0.3142	0.3372	0.2921	0.3824	-1.53	A
	(MG)	4	0.4658	0.5054	0.4425	0.5683	-1.89	A
O-XYLENE (OXY)	(MG)	1	0.6144	0.6125	0.5105	0.7144	0.06	A
	(MG)	2	0.2098	0.2116	0.1703	0.2529	-0.13	A
	(MG)	3	0.8530	0.8793	0.7374	1.0211	-0.56	A
	(MG)	4	0.0977	0.0983	0.0749	0.1217	-0.08	A
TOLUENE (TOL)	(MG)	1	0.2128	0.2124	0.1828	0.2421	0.04	A
	(MG)	2	0.6587	0.6688	0.5769	0.7606	-0.33	A
	(MG)	3	0.0992	0.1004	0.0863	0.1145	-0.25	A
	(MG)	4	0.8733	0.8888	0.7678	1.0099	-0.38	A

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  Asbestos results are calculated based on transformed data. Therefore, asbestos performance limits are
  not symmetrical to the mean values.
Upper limit: mean value + 3 standard deviations
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& Z Score = (reported result-mean value)/standard deviation
@ A: Analysis acceptable   -: Results not reported
  H: Results > upper limit (Z > 3), not acceptable   L: Results < lower limit (Z < -3), not acceptable
Note: the acceptability of reported results is based on z-scores. This is why a reported result may appear
      acceptable according to performance limits, but be identified as an outlier.

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
LABORATORY YEAR-TO-DATE PERFORMANCE REPORT FOR ROUND 145
LAB ID=102959   MAY 14, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

SAMPLE TYPE	ROUND	ROUND * PERFORMANCE	ACCUMULATED PERFORMANCE 4 ROUNDS (%)		2 ROUNDS (%)		PROFICIENCY RATING #
METALS	142	12/12					
	143	12/12					
	144	12/12					
	145	12/12	48/48	100	24/24	100	P
ASBESTOS/FIBERS	142	4/4					
	143	4/4					
	144	4/4					
	145	3/4	15/16	94	7/8	88	P
ORGANICS	142	12/12					
	143	12/12					
	144	4/4					
	145	12/12	40/40	100	16/16	100	P

* The denominators represent the total number of samples to be analyzed.
  The numerators represent the number of acceptable results.
  A '-' represents non-submittal and is calculated as a zero in the numerator.
P : Proficient   N: Nonproficient
  Performance ratings are based on expected results over four rounds (one year).   A lab's
  performance on each sample type is rated proficient (P), if: 1) three-fourths   (75%) or more
  of the accumulated results over four rounds are acceptable or 2) for the   last two rounds,
  all samples are analyzed and the results are 100% acceptable. If a   laboratory receives
  samples for a contaminant and does not report the data, the results will be   considered
  unacceptable for that contaminant.

AIHA

The Essential Source

February 20, 2001

WILLIAM LOWRY CIH
ENVIROHEALTH TECHNOLOGIES INC.
3830 WASHINGTON BLVD.
SUITE 123
ST. LOUIS MO 63108

Lab ID# 102959

Dear WILLIAM LOWRY CIH

Enclosed are your Proficiency Analytical Testing (PAT) Round 144 results.

PAT round 145 sample kits will be mailed to laboratories around April 1, 2001; and results will be due to AIHA on May 1, 2001. The analytes for round 145 are:

> **Metals - cadmium, lead, zinc**
> **Organics - benzene (BNZ), o-xylene (OXY), toluene (TOL)**
> **Asbestos - chrysotile (one manmade fiber)**

If you have any questions, please contact Fred Grunder at AIHA, (703) 849-8888.

Your Password to enter data via the internet is now included on the submission form included with the samples. Your password is in the upper left hand corner (next to your lab ID#) of the mailing address label. Please do not call AIHA for your password. Because of security concerns, passwords will not be given over the phone.

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Note: The Policies for 2001 comply with ISO 17025.

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1.   Industrial Hygiene Laboratory Accreditation Program (IHLAP) including Bulk Asbestos as an analyte
2.   Environmental Lead Laboratory Accreditation Program (ELLAP)
3.   Asbestos Analysts Registry (AAR)
4.   Environmental Microbiology Accreditation Program (EMLAP)

Sincerely,

[signature]

Fred Grunder, CIH

American Industrial Hygiene Association
2700 Prosperity Ave., Suite 250, Fairfax, VA 22031
(703) 849-8888 (703) 207-8558 fax
InfoFax Service Line (703) 641-INFO or Internet: infonet@aiha.org

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
INDIVIDUAL LABORATORY REPORT FOR ROUND 144
LAB ID=102959   FEBRUARY 9, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

CONTAMINANT (ABV.)	UNIT	SAMPLE NO.	REPORTED RESULTS	MEAN VALUES *	ACCEPTABLE RANGE# LOWER	UPPER	Z & SCORE	LAB @ PERFORMANCE
CADMIUM (CAD)	(MG)	1	0.0039	0.0039	0.0033	0.0045	0.04	A
	(MG)	2	0.0098	0.0098	0.0085	0.0111	0.01	A
	(MG)	3	0.0128	0.0127	0.0111	0.0143	0.20	A
	(MG)	4	0.0195	0.0195	0.0171	0.0218	0.05	A
CHROMIUM (CHR)	(MG)	1	0.2086	0.2234	0.1832	0.2636	-1.11	A
	(MG)	2	0.0790	0.0824	0.0684	0.0963	-0.72	A
	(MG)	3	0.0981	0.1015	0.0841	0.1188	-0.58	A
	(MG)	4	0.1450	0.1525	0.1259	0.1792	-0.85	A
LEAD (LEA)	(MG)	1	0.0428	0.0450	0.0391	0.0509	-1.10	A
	(MG)	2	0.0644	0.0646	0.0566	0.0725	-0.06	A
	(MG)	3	0.0842	0.0842	0.0741	0.0943	0.00	A
	(MG)	4	0.0918	0.0987	0.0869	0.1106	-1.75	A
ASBESTOS/FIBERS (ASB/MMF)	(F/MM2)	1	99.0000	107.7742	52.8094	182.1384	-0.42	A
	(F/MM2)	2	557.0000	507.5547	297.2145	773.8433	0.61	A
	(F/MM2)	3	290.0000	276.1539	150.5577	439.5549	0.28	A
	(F/MM2)	4	121.0000	90.9387	44.5600	153.6864	1.54	A
METHANOL (MOH)	(MG)	1	0.0998	0.1004	0.0728	0.1280	-0.06	A
	(MG)	2	0.4824	0.4891	0.3941	0.5841	-0.21	A
	(MG)	3	0.2403	0.2439	0.1907	0.2970	-0.20	A
	(MG)	4	0.8619	0.8692	0.7102	1.0282	-0.14	A

* Mean values are the mean of all laboratories based on original scales except for asbestos.
  Asbestos results are calculated based on transformed data. Therefore, asbestos performance limits are
  not symmetrical to the mean values.
\# Upper limit: mean value + 3 standard deviations
  Lower limit: mean value - 3 standard deviations
& Z Score = (reported result-mean value)/standard deviation
@ A: Analysis acceptable   -: Results not reported
  H: Results > upper limit (Z > 3), not acceptable   L: Results < lower limit (Z < -3), not acceptable
Note: the acceptability of reported results is based on z-scores. This is why a reported result may appear
      acceptable according to performance limits, but be identified as an outlier.

PROFICIENCY ANALYTICAL TESTING (PAT) PROGRAM
LABORATORY <mark>YEAR-TO-DATE PERFORMANCE REPORT FOR ROUND 144</mark>
LAB ID=102959   FEBRUARY 9, 2001
ENVIROHEALTH TECHNOLOGIES INC., ST. LOUIS, MO 63108

| SAMPLE TYPE | ROUND | ROUND * PERFORMANCE | ACCUMULATED PERFORMANCE | | | | PROFICIENCY RATING # |
			4 ROUNDS	(%)	2 ROUNDS	(%)	
METALS	141	12/12					
	142	12/12					
	143	12/12					
	144	12/12	48/48	100	24/24	100	P
ASBESTOS/FIBERS	141	4/4					
	142	4/4					
	143	4/4					
	144	4/4	16/16	100	8/8	100	P
ORGANICS	141	8/8					
	142	12/12					
	143	12/12					
	144	4/4	36/36	100	16/16	100	P

* The denominators represent the total number of samples to be analyzed.
The numerators represent the number of acceptable results.
A '-' represents non-submittal and is calculated as a zero in the numerator.
\# P : Proficient   N: Nonproficient
Performance ratings are based on expected results over four rounds (one year).   A lab's
performance on each sample type is rated proficient (P), if: 1) three-fourths   (75%) or more
of the accumulated results over four rounds are acceptable or 2) for the   last two rounds,
all samples are analyzed and the results are 100% acceptable. If a   laboratory receives
samples for a contaminant and does not report the data, the results will be   considered
unacceptable for that contaminant.